PLANT REMAINS OF THE HENGISTBURY AND BARTON BEDS

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PLANT REMAINS OF THE HENGISTBURY AND BARTON BEDS

By M. E. J. CHANDLER

SYNOPSIS

Plants are described from the isolated headland of Hengistbury, Hampshire and the Bartonian of Highcliff and Barton on the mainland. The geology of Hengistbury is briefly discussed and alternative suggestions as to the position of these beds with reference to the Bartonian and pre-Bartonian are summarized, especial mention in this connection being made of Mr. D. Curry's discovery of *Nummulites prestwichianus* in the Upper Hengistbury Beds. The distribution of the plants in the strata and a plant-list are given showing eighteen families, twenty-one genera. Twenty-four species are described. The large number of water plants is noted and the presence of tropical elements in *Nipa* and Mastixioideae. Almost as many species pass into the Barton or younger beds as are found in the Bournemouth Marine Beds and Highcliff Sands.

For Bartonian geology use is made of E. St. John Burton's detailed classification of the strata. Earlier records of plants are few but recent discoveries have added much to our knowledge of the Lower Bartonian plants especially of Horizon A3. The plant-list of the whole Bartonian comprises seventeen families, twenty-two genera. At least twenty-eight species are described. Again a fairly large number of water plants are present and the characteristic tropical families Capparidaceae, Anonaceae, Icacinaceae and Mastixioideae occur. A species of *Stratiotes*, common in the Bournemouth Marine and Hengistbury Beds, dies out at the top of the Bartonian. The plants alone do not appear at present to throw any new light on the relationship of the Hengistbury Beds to the coastal sequence.

INTRODUCTION

In the following pages plant remains from two sites in close geographical proximity are described. The specimens are due to the persevering efforts of Mr. D. Curry unless otherwise stated.

The deposits of Hengistbury Head, Hampshire, have been regarded by different workers as Auversian or Bartonian.

The Barton Beds of the type section at Highcliff and Barton cliffs in the same County on the mainland include the strata above the Highcliff Sands of Cliff End near Mudeford, Hampshire (see Table, Chandler, 1960 : 8))

The limits of the formation adopted are those given by E. St John Burton in 1933. The Barton Beds are truly marine and well documented with a rich fauna. They pass gradually upwards at Beckton Bunny through transition beds into the estuarine and freshwater deposits of the Lower Headon of Hordle Cliff.

I. THE HENGISTBURY BEDS

1. *Geology*

Hengistbury Head is an isolated promontory connected with the mainland only by a low neck of sand dunes in which no Tertiary strata are exposed. Consequently

the exact stratigraphical relationship between the beds of the Headland and mainland is obscure. The uncertainty has not yet been resolved beyond doubt by reference to palaeontological and lithological evidence.

The lowest beds exposed are seen at the south-western end of the Headland. They consist of white, grey and black sands which have yielded to the writer a few fruits and seeds and would probably provide greater variety if persistent search were made. From them have come *Sequoia*, *Caricoidea*, *Scirpus*, *Stratiotes*, *Brasenia*, *Vitis*, *Cleyera*? and *Rhamnospermum*. It is here that Clement Reid is thought to have obtained *Nipa* (see p. 208). These dark sands extend in an easterly direction for about half a mile along the section before they disappear below sea-level. They have sometimes been regarded as the top of the Boscombe Sands but may be equivalent to the Highcliff Sands of Cliff End, near Mudeford.

Overlying these lowest sands are a Lower and an Upper Series of " Hengistbury Beds ". They are said (White, 1917 : 34) to be sub-littoral marine deposits laid down in water of moderate depth. They were regarded by Gardner (1879 : 211–217) as occurring between the Boscombe Sands and the Cliff End Beds (= Highcliff Sands) of the mainland and if so are probably Auversian. Prestwich (1849 : 43–46) referred them to the Bartonian, a correlation supported by Cowper Reed (1913 : 101–103) on the somewhat inconclusive evidence of a poorly preserved fauna in the Upper Series. The discovery of *Nummulites prestwichianus* by Mr. D. Curry (1942 : 99, pl. 3) in Hengistbury Beds 15 ft. above the basal pebble bed of the Hengistbury Series also suggests Bartonian age and may thereby afford some support for the view that the sands below the Hengistbury Series really belong to the Highcliff Beds, i.e. the beds below Burton's Horizon A1 of the Bartonian (see Curry, 1942 : 88–101).

The Lower Hengistbury Beds are dark olive-green sandy clays with much glauconite and a flint-pebble layer at the base. Their full thickness is exposed in the south-west face of the Headland. They begin to dip beneath the sea about halfway along the cliff face, and finally disappear close to the north-east angle of the Head.

The Upper Hengistbury Beds, well seen in the south-east face, are also glauconitic in places and are laminated silty clays with sandy partings. They may be pale chocolate or dark grey in colour and contain several layers of ironstones (" doggers "). Cowper Reed's fossils were found between the two highest layers of ironstone. It is noted in the Survey Memoir that five out of the six species which he identified with certainty are common to the Bracklesham and Barton Beds.

A few foraminifera were described from the clays below the ironstones by Chapman (1913 : 555). Their small dimensions and general condition suggested to him that they were the survivors of a normal " deep water ferruginous facies " in the uncongenial surroundings of the tidal estuary of a great river (p. 558). Chapman considered that the glauconite in the deposits (which is much worn) may in such circumstances have been derived from " local, disintegrated and resorted, moderately deep-water deposits ", similar to those seen in the Barton and Bracklesham Beds.

Above the Hengistbury Series are conformable yellow and white sands which

have hitherto yielded no plant remains. They have generally been correlated with the Highcliff Sands of the mainland cliffs at Cliff End near Mudeford (White, 1917 : 36, 37). If, however, Prestwich, Keeping, Cowper Reed and Curry (1942) are right as to the age of the Hengistbury Beds, the sands here described would naturally be placed higher in the Bartonian Series (cf. Table, Chandler, 1960 : 8).

2. *Distribution of the Plants*

The occurrence of plants in the dark sands at the base of the section has already been mentioned.

In the Lower Hengistbury Beds, cones described here as *Pinus dixoni* (Bowerbank) Gardner were found on the foreshore in the upper part of the beds by Mr. E. St. John Burton at the south-eastern end of the Headland. It may be noted in passing that cones probably belonging to the same species were also found by him at Horizons A1, A3, D and E in the Barton Beds of Barton cliff.

In the Upper Hengistbury Beds plants were obtained by Mr. D. Curry at the following horizons : 15 ft. above the basal pebble bed of the Hengistbury Series in the *Nummulites prestwichianus* bed (the Lower Series is stated by the Geological Survey to be 12 ft. thick and the Upper Series 49 ft.) ; 19 ft. above the basal pebble bed (about 3 ft. below the lowest line of concretions or doggers) ; 25 ft. above the pebble bed (about 3 ft. above the lowest line of concretions) ; 40 ft. above the pebble bed (between the two top lines of concretions). A few specimens were labelled " between the three rows of concretions (i.e. between 22 and 40 ft. above the basal pebble bed). There appears to be no special significance in the plants found at the different levels.

Curry's plants were obtained while he was sifting for shells and *Nummulites*. The method he was obliged to employ in these clayey deposits to get them to disintegrate inevitably broke some of the carbonaceous fruits and seeds. Quite apart from this, however, many of the specimens must have been battered and fragmentary as is commonly the case where carbonaceous fossils are preserved in clay marine beds to which they may have been somewhat roughly transported. Many of these specimens are partly impregnated with pyrites and are peculiarly liable to decay. Although the yield is poor, as so often in clay beds, prolonged effort would provide at least a few additions to the list of plants at present available. On the south-eastern face, the work of collecting is now hampered by a sea-wall which prevents the sea from cutting into the face of the cliff thereby providing fresh surfaces where the plants are not rotted through long exposure to the weather. The sands in the south-western face may still be profitably worked, for they fall to pieces more readily than the tenacious sandy clay so that specimens from this locality are more easily extracted without damage.

Many of the " doggers " in the Upper Hengistbury Beds contain indeterminable fragments of battered wood. There are also occasional fruits and seeds (also noted by Prestwich, 1849 : 45–46) some of which may be recognizable although they are difficult to extract whole.

3. *List of Hengistbury Plant Remains*

Family	Genus and species	Horizon and Remarks B. Basal beds of Headland L. Lower Hengistbury Beds U. Upper Hengistbury Beds		Range summarized (O.*, Y.†)
Araucarineae	*Araucarites* sp. (? *A. sternbergi* Goeppert)	U.	In Bournemouth Beds	O.Y.
Abietineae	*Pinus dixoni* (Bowerbank) Gardner	L.	In Barton Beds. Cones	Y.
	Pinus sp.	U.	Leaf fragments	
Taxodineae	*Sequoia couttsiae* Heer	B.U.	In Lower Bagshot to Hamstead Beds	O.Y.
Potamogetonaceae	*Limnocarpus headonensis* (Gardner)	U.	Water plant. Bournemouth Marine to Hamstead Beds	O.Y.
Hydrocharitaceae	*Stratiotes hantonensis* n. sp.	B.U.	Water plant. Chiefly Bournemouth Marine to Bartonian Beds	O.Y.
Cyperaceae	*Scirpus lakensis* n. sp.	B.	Water or subaquatic. Lower Bagshot and Bournemouth Freshwater Beds	O.
	Caricoidea obscura n. sp.	U.	Water or subaquatic. Lower Bagshot to Upper Headon Beds	O.Y.
	Caricoidea sp. (? *C. obscura*)	B.		
	Caricoidea maxima n. sp.	U.	Water or subaquatic	
Palmae	*Palmophyllum* sp.	U.	Fan-palm leaf of type found in Lower Bagshot and Bournemouth Marine Beds	O.Y.
Nipaceae	*Nipa burtini* (Brongniart)	B.	Mangrove swamps. London Clay, Bournemouth Marine Beds and a leaf ? at Hordle	O.Y. ?
Moraceae	Genus ?	U.		
Caryophyllaceae	*Hantsia pulchra* (Chandler)	U.	Bournemouth Marine to Lower Headon Beds, Hordle	O.Y.
Nymphaeaceae	*Brasenia ovula* (Brongniart)	B.U.	Water plant. Bournemouth Marine to Hamstead Beds	O.Y.
Burseraceae	*Palaeobursera* sp.	U.	(cf. *Palaeobursera* sp. from Lower Bagshot to Lower Headon Beds, Hordle)	O.?Y.?
Vitaceae	*Vitis* n. sp.	B.	Lower Bagshot Beds	O.
Theaceae	*Cleyera* ? *variabilis* (Chandler)	B.U.	Woolwich, Oldhaven, London Clay, Bournemouth Freshwater to Lower Headon Beds	O.Y.
Thymeliaceae	*Daphne* sp.	U.	Bournemouth Beds	O.
Epacridaceae	*Epacridicarpum mudense* n. sp.	U.	Bournemouth Marine to Lower Headon Beds	O.Y.
Cornaceae (Mastixioideae)	*Mastixicarpum crassum* Chandler	U.	Lower Bagshot to Lower Headon Beds	O.Y.
Symplocaceae	*Symplocos* sp. (? *S. headonensis* Chandler)	U.	Lower Bagshot to Lower Headon Beds	O.?Y.?
Family ?	*Rhamnospermum bilobatum* Chandler	B.U.	Water plant ? Lower Bagshot to Hamstead Beds	O.Y.
	Carpolithus cornutus n. sp.	U.		
	Carpolithus spp.	U.		

* Also in older beds than the Bartonian. † Also in Bartonian or younger beds.

4. *Analysis of the Plant List*

There appears to be no significant variation of the flora from one part of the section to another. There are eighteen families, twenty-one genera including two form-genera and twenty-four species. Almost all of the last have been found at horizons below the Bartonian (see species marked O in list). Nearly as many (marked Y in list) occur in the Barton Beds of Barton, the Lower Headon or younger beds. Of these

Nipa may be represented by leaves in the Lower Headon. Fragmentary fan-palm leaves (probably *Sabal*) occur in the horizons noted and larger fragments attributed to *Sabal* in the London Clay and Hamstead Beds. An interesting point is that the species *Stratiotes hantonensis* ranges from the Bournemouth Freshwater Beds (only one seed found) up to and including the Barton Beds of Barton cliff but it then disappears and its place is taken by *Stratiotes headonensis* Chandler in the passage beds at Long Mead End and succeeding Lower and Upper Headon Series.

The above analysis suggests that at present there is no definite evidence as to the age of the Hengistbury Beds afforded by the plants. These are disappointingly sparse as is normally the case when the flora of a period has to be derived from marine deposits. The well-known exception is the London Clay flora where the conditions of preservation are unusual and the opportunities for collecting unique. Of the small total at least eight are water or marsh plants (see list). They are presumably derived from coastal marshes, riverside bogs and lagoons or other quiet stretches of water, fresh or brackish. *Nipa*, *Palaeobursera* and *Mastixicarpum* are very definite tropical elements and, as often, are associated with *Sequoia couttsiae* the ubiquitous Eocene conifer, and with *Hantsia pulchra*, *Cleyera? variabilis*, *Symplocos headonensis* and the enigmatic *Rhamnospermum bilobatum* as well as with the water plants *Caricoidea obscura* and *Scirpus lakensis*.

II. THE BARTONIAN OF BARTON CLIFF

1. *Geology and Mode of Preservation of Plants*

The geological section in Barton cliff was described in considerable detail and the successive horizons lettered Beds A to L by E. St John Burton in 1933. The section is classical and its rich fauna is well known. While this famous fauna is a warm one it appeared to Prestwich (1857 : 131) to be less tropical in character than that of the Bracklesham Beds and it is stated that some of the large tropical shells had disappeared by Bartonian times (Gardner, Keeping & Monckton, 1888 : 584).

Plant remains, unlike animals, are scarcely known. They are sparse, poorly preserved and frequently unidentifiable, owing to a heavy encrustation of pyrites. They have obviously drifted for long in salt water and are the scanty remains of plant life from a contemporary land-surface with streams and fringing marshes draining into the Barton sea. With the exception of rare mineral casts in Bed K, the plant fossils are normally preserved as carbonaceous entities heavily impregnated with a dull lustreless pyrites mud and liable to quick decay. It is a most unfortunate circumstance that a flora so scarce should be almost impossible to preserve for any length of time. Specimens must usually be described and illustrated immediately on discovery for in a few weeks or months at latest, many may have disintegrated or seriously deteriorated. It is therefore of great importance to record and illustrate as fully as possible these ephemeral specimens ; for if the records are not made all information will be lost with the decay of the specimens themselves. Better by far careful records without specimens than no records at all. Mere

names unsupported by descriptions and figures are valueless as has been demonstrated by much of Gardner's work.

2. *Old and New Discoveries of Plants*

The earlier reports of plants are few. In 1884 Gardner described and figured two very imperfect cones under the names *Pinus dixoni* (Bowerbank) (p. 66, pl. 13, fig. 5) and *P. bowerbanki* (Carruthers) (p. 68, pl. 13, fig. 6). The figures suggest that they were hardly in a state for satisfactory specific identification, a point fully realized by Gardner. Both cones were said to come from the " Middle Bagshot of Highcliff" [= Lower Barton]. He also figured from this horizon a coniferous twig which he named " *Araucaria goepperti*? Sternberg " (1883 : 59 ; 1884, pl. 13, fig. 10).

In 1887 (p. 249) he alluded to " nearly a dozen pine cones ... from the Highcliff Beds which go far to prove that there is only one variety here, indistinguishable from the *Pinus Dixoni* of Bracklesham ". He added that " along with these we have branches of apparently the Bournemouth *Araucaria*, and an important and entirely new fruit, fortunately represented by many specimens, which permit us to examine the details of their structure. These consist of twigs on which are seated in some profusion clusters of numerous sessile woody pericarps with deeply laciniate margins, giving the fruit when closed the appearance of a large burr. These enclose a nut or seed, rather smaller, but otherwise resembling that of a cucumber ... ". The specimens no longer exist and it is impossible to make a guess as to what these fruits may have been.

The richest haul of plant fossils from Barton on record was made in 1952 by D. Curry. In a letter dated January of that year he writes that A3 " consists of dark grey silty clays with few fossils. Within the clays are found thin seams of a pure silt which passes readily through a sieve without previous drying. These have obviously been produced by current action which has disturbed and re-sorted the associated clays. One result of this sorting has been the accumulation of the contained fossils in rare, but rich, pockets of small size ". Curry also states that " the fossil content of individual pockets varies considerably. Some contain a preponderance of thin lamellibranchs, others the heavier gastropods. In some there is an appreciable mixture of estuarine shells, with even rarer freshwater and land forms. Some contain a fair proportion of vegetable matter with the shells ".

The pocket from which most of the specimens hereafter described were collected was found at Highcliff where Bed A3 comes down to beach level about a quarter of a mile east of Chewton Bunny. Here Mr. Curry wrote there were " the remains of a log of wood and the shells had obviously been caught by an eddy on its lee side. There was a lot of vegetable débris among the shells and seeds were, for this horizon, unusually common ". About half a bucketful of sand was sifted. A few plants were also found by him at Horizon A2.

In the systematic descriptions which follow, the horizons (after Burton, 1933) from which specimens were obtained are indicated where possible but most collectors other than Curry have not given so much detail.

3. *List of Bartonian Plants*

Family	Genus and species		Horizon and Remarks
Araucarineae	? *Araucarites sternbergi* Goeppert	C	Also in Bournemouth Freshwater and Marine Beds
Abietineae	*Pinus* sp. (? *P. bowerbanki* (Carruthers))	C, D	
	Pinus sp. (? *P. dixoni* (Bowerbank))	A1, A3, D, E	Also in Hengistbury Beds
Taxodineae	*Sequoia couttsiae* Heer	A3, D, L	Also in Lower Bagshot, Hengistbury to Hamstead Beds
Family ? (Coniferae)	Genus ?	A3	
Potamogetonaceae	*Limnocarpus headonensis* (Gardner)	K	Water plant. Bournemouth Marine to Hamstead Beds.
Hydrocharitaceae	*Stratiotes hantonensis* Chandler	A3	Water plant. Bournemouth Marine to Barton Beds. Rare in Bournemouth Freshwater Beds.
	Stratiotes headonensis Chandler	L	Water plant. Lower and Upper Headon Beds.
Cyperaceae	*Caricoidea obscura* Chandler	A3	Water or subaquatic. Lower Bagshot to Upper Headon Beds.
Nymphaeaceae	*Brasenia ovula* (Brongniart)	A3, K, L	Water plant. Bournemouth Marine to Hamstead Beds.
Capparidaceae ? or Theaceae ?	Genus ?	A3	Family in Lower Bagshot and Bournemouth Freshwater Beds.
Anonaceae	*Anonaspermum* sp.	Bartonian horizon ?	Family in London Clay and Bournemouth Freshwater Beds.
Rutaceae	*Rutaspermum* sp.	Bartonian horizon ?	Genus London Clay to Colwell.
	Rutaspermum sp.	A2	
Icacinaceae	*Icacinicarya pygmaea* n. sp.	A3	Family Palaeocene to Headon Beds.
	Icacinicarya bartonensis n. sp.	K	
	Genus ? (? *Natsiatum eocenicum* Chandler)	A3	
	Stizocarya sp.	Middle Bartonian	London Clay (to Headon ?).
Theaceae	*Hordwellia crassisperma* (Chandler)	A3	Lower Bagshot to Upper Headon Beds.
	Cleyera ? *variabilis* (Chandler)	A3	Bournemouth Freshwater to Lower Headon Beds.
	Cleyera ? *bartonensis* n. sp.	A3	
Thymeliaceae	? *Daphne* sp.	A3	Hengistbury and Bournemouth Marine Beds.
	Genus ?	A3	
Lythraceae	*Decodon gibbosus* (E. M. Reid)	A3	Subaquatic. Upper Headon, Pliocene.
	Diclidocarya minor n. sp.	A3	Subaquatic. Genus German Brown Coal.
	Palaeolythrum bournense n. sp.	A3	Subaquatic. Bournemouth Freshwater to Upper Headon and Bovey.
Cornaceae (Mastixioideae)	*Eomastixia rugosa* (Zenker)	Lower and Middle Bartonian	Lower Bagshot to Lower Headon Beds.
Epacridaceae	*Epacridicarpum headonense* n.sp.	A3	Bournemouth Marine, Hengistbury, Lower Headon, ? Upper Headon Beds.
	?Epacridicarpum mudense Chandler	A3	Bournemouth Marine, Hengistbury, Lower Headon Beds.
Symplocaceae	*Symplocos* sp.	A3	
Family ?	*Rhamnospermum bilobatum* Chandler	A3, L	Probably water plant. Lower Bagshot to Hamstead Beds.
	Carpolithus spp.	Lower Bartonian horizon ? A3	

4. *Analysis of the Flora and Range of its Species*

Seventeen families have been recognized up to date with twenty-two genera including such form-genera as *Icacinicarya* and *Epacridicarpum*. There are at least twenty-eight distinct species some of which cannot be named for lack of sufficient data to define them and it may be noted that eleven are probably true water plants or subaquatic but these two groups, as a rule, give little information as to climate. The presence, however, of the families Capparidaceae, Anonaceae, Icacinaceae (with four representatives) and Mastixioideae indicates a considerable measure of warmth. *Stizocarya* is itself a London Clay genus. *Eomastixia* has been traced from the Pipe-clay Series of Dorset, through the Bournemouth Freshwater and Marine Beds up to the Lower Headon, but not, so far, into younger beds.

In addition to these definitely warmth-loving plants the following are associated with warm floras at other horizons: *Araucarites sternbergi, Sequoia couttsiae, Caricoidea obscura, Hordwellia crassisperma, Cleyera? variabilis, Palaeolythrum bournense*, and the puzzling *Rhamnospermum bilobatum*. Two of these, *Sequoia* and *Rhamnospermum* continue to thrive in the Bembridge and Hamstead Beds where some cooling of the climate may perhaps have occurred.

In addition the Barton, Cliff End and Bournemouth Marine Beds share a number of species which are wholly or almost absent at horizons below the Marine Beds so far as present knowledge goes. Thus the water plants *Brasenia ovula* and *Limnocarpus headonensis* are found almost universally in the Tertiary plant beds of southern England but only from the Bournemouth Marine Beds onward apart from a single endocarp of *Limnocarpus* from the Cuisian of Whitecliff Bay, Isle of Wight. Again *Microdiptera parva* supersedes, at this same horizon an older, larger species, awaiting publication from the Bournemouth Freshwater Beds. These three species all survive into the Oligocene. In like manner the Epacridaceae make their first recorded British appearance in the coast section in the Bournemouth Marine Beds and are known also from the Highcliff Sands at Cliff End, near Mudeford as well as from the Hengistbury Beds, Lower Headon, and Upper Headon of Colwell. The range of *Stratiotes hantonensis* is mentioned on p. 199. It is essentially a Bournemouth Marine to Bartonian species. These records suggest that the passage from Bournemouth Freshwater to Bournemouth Marine Beds may mark a phase in the development of the Eocene flora.

The genus *Decodon* calls for special mention for up to date it is in the Barton Beds that it is first found in England. The species *D. gibbosus* (E. M. Reid) was based on Pliocene seeds from Pont-de-Gail (Cantal), France, and has now been recognized also at an intermediate horizon in the Upper Headon of Colwell.

5. *Concluding Remarks*

While (unpublished) knowledge of the floras of the Bournemouth Marine Beds and Highcliff Sands is fuller than that of the Barton and Hengistbury floras, there is, on the whole, no significant change between the oldest and youngest of these

beds. It is therefore impossible at present to differentiate between these successive stages on the basis of the plants alone. Hence it follows that there can be no grounds for relating the Hengistbury flora to that of the Highcliff Sands or Bournemouth Marine Beds on the one hand rather than to the Barton flora on the other. This opinion agrees with the one expressed on p. 197 after a study of the Hengistbury plants. Detailed consideration of the Barton flora also confirms that, in the present stage of knowledge, the plants have little to contribute to the problem of the age of the much discussed Hengistbury Beds.

The author's warmest thanks are due to Dr. K. I. M. Chesters and Mr. F. M. Wonnacott for much valued help and criticism in the prepation of this paper.

SYSTEMATIC DESCRIPTIONS

1. *Plant Remains from Hengistbury Head, Hampshire*

GYMNOSPERMAE

Order CONIFERALES

Family ARAUCARINAE

Genus ***ARAUCARITES*** Presl 1838

Araucarites sp. (? ***Araucarites sternbergi*** Goeppert)

(Pl. 29, figs. 1–3)

1850. *Araucarites sternbergii* Goeppert, pl. 44, fig. 1.
1883. ? *Araucarites goepperti* (Sternberg) : Gardner, p. 59.
1884. ? *Araucarites goepperti* (Sternberg) : Gardner, pl. 12, fig. 10.

The species described by Gardner from the Bournemouth Beds appears to be represented by small fragments of twig, usually pyritized and much corroded. The reasons for assigning the Bournemouth material to *A. sternbergi* Goepp. are given by Florin in Reid & Chandler (1926 : 50).

One poorly preserved twig from the Upper Hengistbury Beds showing long falcate leaves was found as an impression in an ironstone nodule (V.36426). Carbonaceous twigs were isolated from the clays between the concretions or "doggers". One of these with spirally arranged leaves shows slightly incurved tips (Pl. 29, fig. 1). It, and a thicker twig, were sacrificed in preparing cuticle (slides V.36349, V.36350, V.36351). The tiny fragments show characteristics of *Araucarites* rather than of *Sequoia couttsiae*, e.g. in the large stomata (length of aperture 0·04–0·05 mm.) and in the coarseness and large size of the epidermal cells. Outside the stomatal bands the ordinary epidermal cells have a tendency to narrow towards their ends (slide V.36351) as in *A. sternbergi* from Bournemouth, inside they are frequently equiaxial.

The cells bear scattered simple pits. One fragment apparently from the ventral surface of the leaf shows several transversely oriented stomata in a longitudinal row. Two of these are separated by four transversely elongate and aligned epidermal cells between their auxiliaries. On what appears to be a fragment of the dorsal surface the stomata are mainly longitudinally aligned. On the decurrent basal regions of the leaf they are most frequently oblique (slide V.36349). V.36350 shows a marginal decurrent ventral fragment with transverse and oblique stomata.

A long falcate detached leaf (Pl. 29, fig. 3) was destroyed in an unsuccessful attempt to prepare cuticle.

Family Abietineae

Genus ***PINUS*** Linnaeus

Pinus dixoni (Bowerbank) Gardner

(Pl. 29, figs. 12, 13 ; Pl. 30, figs. 14, 15)

1850. ? *Pinites dixoni* Bowerbank *in* Dixon, , p. 84, pl. 9, fig. 3.
1878. ? *Pinites dixoni* Bowerbank : Carruthers *in* Dixon, p. 162.
1884. *Pinus dixoni* (Bowerbank) Gardner, p. 66, pl. 13, figs. 1, 2, 5, 8 ; text-fig. 27.

Amended diagnosis. Cones elongate-ovoid, scales with rhomboidal apophyses with prolonged umbo and transverse carina, apophyses ornamented with divergent striae. Dimensions of apophyses about 12·5 × 7 mm. Length of cone (not quite complete), 7·5 cm. ; breadth (much compressed), 3·5 cm.

Neotype. A cone imperfect at the base. Brit. Mus. (N.H.), No. V.36352.

Description. *Cone* : Elongate-ovoid (incomplete at the base, much compressed in fossilization). Scales with rhomboidal apophyses the larger of which are about 12·5 mm. in transverse diameter by about 7 mm. in height, with a dorsal prolonged umbo and a transverse carina ; on the apophyses are divergent striae especially conspicuous below the carina. Length of cone preserved, 7·5 cm. ; breadth, 3·5 cm.

Remarks and affinities. Two cones, one (V.36352) with about seventy-six scales preserved, imperfect at the base, the other (V.36353) much more incomplete. Both were found by E. St John Burton. In the dimensions and form of the cone, and in the character and size of the apophyses, there is a close resemblance to a specimen of *Pinus dixoni* from Bracklesham figured by Gardner in 1884 (pl. 13, figs. 1, 2). Gardner later stated (1887 : 249) that he had also found a dozen cones indistinguishable from *P. dixoni* in the Highcliff Beds (Lower Bartonian), but only a fragmentary cone from Highcliff was figured by him under this specific name (1884, pl. 13, fig. 5). It may be presumed that these cones quickly shed their scales, as is liable to happen when they are released from the matrix, so that they could not be illustrated. A similar cone (now decayed) with similar scales was found by E. St John Burton in the Middle Bartonian (Horizon D) in Barton cliffs (see p. 220, Pl. 33 figs. 75–79).

Gardner also referred two cones from the Bembridge Marls of Gurnet Bay to this species (1884 : 67, pl. 13, fig. 4) but the apophyses were not well shown and the specific identity cannot be satisfactorily established unless (as is again possible) the apophyses were preserved at the time of the discovery and decayed before the plate was drawn (cf. Reid & Chandler, 1926 : 53, 54).

Pinus sp.

(Pl. 29, figs. 4–11)

Fragments of pine-needles occur throughout the Upper Hengistbury Beds. They have been collected at unspecified horizons between the three rows of concretions (V.36354) and at 15 (V.36355), 25 (V.36356, V.36357, V.36359, V.36360) and 40 ft. (V.36358) above the basal pebble bed. The longest fragment measures 5 mm. and is 1·25 mm. broad. One surface of the needles is always gently convex with several clearly defined lines of close-set stomata. There may be five, six, or seven lines, but usually there are six or seven (Pl. 29, figs. 5, 9, 10). The other surface is more or less sharply ridged or angled longitudinally, the ridge being asymmetrically placed in most fragments and flanked by a more or less conspicuous furrow on each side beyond which the surface flattens out, but there are less conspicuous subsidiary ridges sometimes visible and clearly seen in the cuticle. There is usually one row of stomata on the ridge as in the specimens figured in Pl. 29, figs. 8, 11. Sometimes there are two contiguous rows in parts of the ridge.

A leaf with seventeen stomatal rows on the convex surface shows two contiguous rows in the hollow of the opposite surface on the broader side and two on the flat region beyond it, with at least four rows on the narrower side of the conspicuous angle (V.36364) (Pl. 29, fig. 11).

A leaf with six stomatal rows on the convex surface shows one row in each hollow of the opposite surface and three rows beyond the hollow on the more flattened region of the leaf.

In another fragment with six rows on the convex surface, there are three rows of stomata flanking the ridge on each side on the opposite surface and on one side of it one of these rows lies in the hollow, all other rows being on the flattened part of the surface.

A fragment with seven rows of stomata (two of which were discontinuous) on the convex surface has three rows on each side of the ridge on the opposite surface two rows being contiguous on each side of the ridge while on the ridge itself the one row is asymmetrically placed.

A fragment with six rows on the convex surface shows on the opposite surface, three rows on one side of the rib with one row on the rib itself and one row (or possibly two adjacent rows not clearly distinguishable) on the opposite side of the rib on the flat part and one in the hollow (Pl. 29, fig. 8).

Attempts were made to prepare cuticle fragments. A few poor fragments were

obtained but they at least show some definite features. Where two rows of stomata are continguous lateral auxiliary cells may be shared by stomata of adjacent rows. Otherwise there may be several rows of ordinary epidermal cells between the rows. Contiguous stomata in the same row may sometimes share a polar auxiliary cell. Auxiliary cells varied (where they could be counted) from 10–14. There are two polar auxiliary cells and four, five, or six lateral auxiliary cells on each side of the pore. The lateral auxiliary cells are isodiametric and densely cuticularized. There is a most conspicuous ring of cuticle on the inner edge of these cells where they join the guard cells. Stomatal pores are about 0·067 mm. in diameter, sometimes 0·08 × 0·05 mm. The lateral auxiliary cells are 0·013–0·014 mm. in diameter. The ordinary epidermal cells of the surface show a superficial reticulate thickening. In places the walls are almost imperceptibly sinuous. In other places they are slightly sinuous. The cells which form the ridges of the surface are larger than the other cells, sometimes square-ended and about 0·03–0·036 mm. broad. The ridges bear short blunt teeth situated about 0·11–0·135 mm. apart (V.36359).

The needles probably belong to a single species. They seem to be specifically distinct from fragments described from Cliff End which (although their preservation made it impossible to prepare cuticle) appear to show a larger number of rows of stomata on the convex surface and simpler ridging of the opposite surface with a broader flatter area flanking the ridge. The character of the stomata with as many as fourteen auxiliary cells and the sharing of lateral auxiliary cells where stomatal rows are contiguous as well as the short isodiametric character of the lateral auxiliaries all indicate the section *Diploxylon* of Koehne for the Hengistbury species.

There is no evidence of connection with the cones described on p. 202 although possibly the two may belong to the same species.

Family Taxodineae

Genus ***SEQUOIA*** Endlicher

Sequoia couttsiae Heer

See references, Chandler, 1957, p. 82.

Small twig fragments from Hengistbury are to be figured in the Lower Bagshot monograph where the species *S. couttsiae* is fully described. Two were collected between the three lines of concretions (" doggers ") in the Upper Hengistbury Series. One twig from the lowest dark sands at the western end of the Head was destroyed in an attempt to prepare cuticle. The solitary slide (V.36365) is very poor but shows tiny fragments in a much decayed condition. Among them are several strips of ventral decurrent cuticle at the base of the leaf showing large cells and a few oblique stomata with auxiliary cells arranged end to end. Poor scraps from the base of the ventral free surface show the middle part and parts of the marginal flanges where they were attached to the twig.

ANGIOSPERMAE

Class MONOCOTYLEDONES

Family Potamogetonaceae

Genus ***LIMNOCARPUS*** C. Reid emend. Reid & Chandler, 1926 : 68

Limnocarpus headonensis (Gardner)

(Pl. 30, figs. 16, 17)

1888. *Carpolithes headonensis* Gardner, p. 420, pl. 3, fig. 30.
1926. *Limnocarpus headonensis* (Gardner) : Reid & Chandler, p. 70, pl. 4, figs. 1–3. See also for other references.

One obovoid locule-cast from which most of the carpel wall has been abraded. The cast shows the curved form and oblique excentric process around which it is curved situated at about one-third of the length from the apex. The style base can be seen at the upper end of the ventral margin. The cast of the germination valve shows that it did not reach the style. Although the removal of the external surface has obscured or destroyed any evidence of external rugosities the size and proportions of this specimen indicate that it belongs to *Limnocarpus headonensis*, a species of frequent occurrence in both older and younger beds of the coast section. In the mode of preservation it agrees with a specimen from the Cuisian of Whitecliff Bay, Isle of Wight (awaiting publication) and with endocarps from Bed K of the Bartonian at Beckton Bunny (p. 222 Pl. 33, figs. 84–86). Length of cast, 1·5 mm. ; breadth, 1·25 mm. ; thickness, 1 mm.

Family Hydrocharitaceae

Genus ***STRATIOTES*** Linnaeus

Stratiotes hantonensis n. sp.

(Pl. 30, figs. 18–25)

Diagnosis. Seed suboval, hooked or sigmoidal in outline, much inflated (although often flattened as the result of fossilization). Keel rather narrow and inconspicuous ; collar rough and nodular in unworn seeds (smooth, rounded and smaller in abraded seeds). Testa woody, ornamented with discontinuous pronounced longitudinal ridges and conspicuous pits (when unworn). Micropyle basal or sub-basal, straight or oblique, hilum from about one-third to one-half of the length from the base in hooked seeds, near the apex (as preserved) in sigmoidal seeds. Raphe marginal to the apex then transverse in hooked seeds, apical and transverse (as preserved) in sigmoidal seeds. Length usually about 2·5–3·5 mm. rarely larger. Largest seed seen : length, 4 mm. ; breadth, 2·25 mm.

Holotype. Brit. Mus. (N.H.), No. V.36484 from the Bournemouth Marine Beds, Southbourne, Hampshire, awaiting publication.

The species is based on better-preserved seeds from Bournemouth Marine Beds the account of which awaits publication. It includes full details of the characters and a discussion of the relationship of these seeds. The Hengistbury seeds, like those from Bournemouth, are suboval, sometimes hooked at the base, sometimes sigmoidal in outline, frequently much inflated although in many instances flattened as the result of fossilization. Keel sharply or scarcely differentiated from the body, merging into the collar at the base. Collar often conspicuous, frequently smooth, sometimes clearly differentiated from the body by a constriction. Testa ornamented externally by conspicuous discontinuous longitudinal ridges and large pits but the appearance varies considerably with the degree of abrasion. Hilum on the keeled margin varying in position from half to one-third from the base in hooked seeds, near the apex at the extremity of the hook or beak in sigmoidal seeds. Raphe marginal to the apex in hooked seeds where it passes directly across the keel to the apical chalaza, remaining only as a short transverse canal near the apex of the keel in sigmoidal seeds. Digitate cells of the interior of the keel elongate parallel to the length of the seed, sometimes sinuous. Dimensions of some typical seeds are $3 \times 1{\cdot}75$ mm.; $3{\cdot}1 \times 1{\cdot}6$ mm.; $3{\cdot}25 \times 2{\cdot}5$ mm.; $3{\cdot}6 \times 2{\cdot}1$ mm.; $4{\cdot}25 \times 2{\cdot}25$ mm.

Remarks. The seeds can be matched exactly in size and characteristics among the seeds of *Stratiotes hantonensis* from the Bournemouth Marine Beds and Highcliff Sands.

Family Cyperaceae

Genus ***SCIRPUS*** (Linn.)

Scirpus lakensis n. sp.

(Pl. 30, fig. 26)

Diagnosis. Fruit narrow-oburceolate in outline with conspicuous basal neck and long terminal persistent style. Surface longitudinally ridged, cells hexagonal, transversely elongate, arranged in longitudinal rows between the ridges (broken-down cell walls often persisting as lines of bristles along the ridges in abraded specimens). Length of fruit, 1·4–2·5 mm.; breadth, 0·65–0·8 mm. Cells as much as $0{\cdot}1 \times 0{\cdot}3$ mm. in diameter.

Holotype. Brit. Mus. (N.H.), No. V.40397 from Lower Bagshot, Lake, Dorset, awaiting publication.

Remarks. The species is based on beautiful material from Lower Bagshot Beds. Only three much abraded fruits have been found at Hengistbury. One (V.36378) is typical, attenuated to the long tapering style with basal neck. Only the inner yellow shining translucent coat is preserved but it shows the longitudinal ridges and between them remains of the transverse hexagonal cells in regular longitudinal rows. Two others (V.36379) are even more worn. Length of best specimen, 1·4 mm.; breadth, 0·7 mm.

Genus ***CARICOIDEA*** Chandler, 1957 : 86

Caricoidea obscura n. sp.

(Pl. 30, figs. 27–33)

Diagnosis. Fruit sub-obovoid, rounded at the apex, truncate at the base, formed of thick spongy parenchyma, surface with longitudinally elongate digitate cells. Length, 1–2 mm. ; breadth about 0·5–1·75 mm. Endocarp obovoid, narrowing gradually to the truncate base, mucronate at the apex. Length about 0·95–1·3 mm. Locule lining longitudinally ridged formed of longitudinal cells. Testa hyaline of transversely aligned cells.

Holotype. Brit. Mus. (N.H.), No. V.40407 from the Highcliff Sands, Cliff End, near Mudeford, Hampshire, awaiting publication.

Remarks. The species is not uncommon at Hengistbury and is represented by both fruits and endocarps. One specimen is represented by an endocarp still adhering to a fragment of fruit. The complete fruits show the typical, laterally angled sub-obovoid form with basal aperture and thick close-textured parenchymatous wall. The endocarps, when isolated, have a distinctly mucronate apex and narrow well-marked neck (cf. V.36381, V.36382 and V.36386). The specimen V.36385 (Pl. 30, fig. 33) may be immature. It is small (1·8 × 1·4 mm.) but is important as it shows the epidermal layer with longitudinally elongate digitate cells. Length of fruit about 2 mm. ; breadth, 1·5–1·75 mm. Length of endocarp, 1·4–1·5 mm. ; breadth, 1·1–1·3 mm.

Caricoidea sp. (?***Caricoidea obscura*** Chandler)

(Pl. 30, fig. 34)

An obovoid endocarp, pointed, almost mucronate, at the apex, gradually narrowed to the truncate base to which remains of the fruit adhere giving a superficial appearance of an expanding neck. The specimen is much compressed so that its structure is somewhat obscure. It may be a crushed specimen of *C. obscura*.

Caricoidea maxima n. sp.

(Pl. 31, fig. 35)

Diagnosis. Fruit obovoid, truncate at the base with deep depression. Length about 4·25 mm. ; breadth about 2·75 mm.

Holotype. Brit. Mus. (N.H.), No. V.36388.

Description. *Fruit*: Sub-obovoid, somewhat flattened (probably original), truncate at the base, with a basin-shaped depression (obscured by adherent sand).

Apex somewhat pointed. External surface abraded so that the epicarp layer is not preserved. Wall compact, formed of equiaxial cells. Endocarp not seen. Length of fruit, 4·25 mm. ; maximum breadth, 2·75 mm.

Remarks. One fruit somewhat battered, abraded, and distorted. It is remarkable for its large size as compared with the other species and has therefore been given the specific name *C. maxima*.

Family Palmae

Genus ***PALMOPHYLLUM*** Conwentz

Palmophyllum sp.

(Pl. 31, figs. 36, 37)

A tiny fragment of the leaf of a small fan-palm showing part of five pinnules near their origin still attached to a piece of the rachis. It is exactly comparable with fragmentary palm leaves from the Lignites above the Boscombe Sands at Southbourne awaiting publication. Surface cells on the pinnae are longitudinally aligned in rows, rectangular or almost square, about 0·01 mm. in diameter. The cells on the Southbourne leaf fragments were not preserved owing to the abrasion of the surface. There can be little doubt that the fragments from the two localities belong to the same species. The fragment from Hengistbury measures 6 × 3·5 mm. and is of *Sabal* type.

Family Nipaceae

Genus ***NIPA*** Thunberg

Nipa burtini (Brongniart)

1894. *Nipadites parkinsonis* (Brongniart) : Rendle, p. 150.
1917. *Nipadites parkinsoni* (Brongniart) : White, p. 34.
1933. *Nipa burtini* (Brongniart) : Reid & Chandler, pp. 119, 128.

The specimen was a sandy cast like those from Honeycomb Chine. It was never figured but is mentioned by Rendle (1894). Reid & Chandler considered that there were no grounds for creating more than one species out of the British material which should all be referred to *N. burtini* (Brongniart).

Class DICOTYLEDONES

Family Moraceae

Genus ?

(Pl. 31, fig. 38)

Description. A much compressed fruit (now broken) shows the typical stylar end of an endocarp of Moraceae. The fruit is suboval in outline, one margin being

more markedly convex than the other, and is narrowed to the terminal style. The attachment and placenta are closely adjacent to the style. Both style and attachment are marked by conspicuous marginal prominences, the attachment being made conspicuous by the recurved remains of the funicle. Length, 2 mm.; breadth, 1.25 mm.

The form and adjacent stylar and funicular prominences at the apex indicate relationship with Moraceae. The specimen is more elongate-oval in outline than *Moroidea boveyana* Chandler (1957 : 95, pl. 13, fig. 74) and its surface is more rugose.

Order CENTROSPERMAE

Family Caryophyllaceae

Genus ***HANTSIA*** nov.

Diagnosis. Seeds with curved embryo belonging to the Centrospermae; large rimmed hilum between the limbs. Testa with smooth or tubercled digitate cells externally. Inner integument of small uniform equiaxial cells.

Type species. *Hantsia pulchra* (Chandler).

Hantsia pulchra (Chandler)

(Pl. 31, fig. 39)

1925. *Corydalis pulchra* Chandler, p. 25, pl. 2, fig. 10*a*, *b*.

Holotype. Brit. Mus. (N.H.), No. V.20051 from Lower Headon of Hordle, Hampshire.

For reasons discussed in a work on the Lower Headon awaiting publication the species has been transferred to the family Caryophyllaceae and to a new genus *Hantsia*. In the same volume new material from the type locality (Lower Headon, Hordle) is compared with material from other new horizons.

Description. A much distorted and broken seed from Hengistbury shows the transversely oboval campylotropous form. Between the unequal limbs lay a large rimmed aperture in the better preserved material from other deposits but not here preserved. The surface, which is black and shining bears large rounded tubercles each arising from a cell or area with finely toothed margin, one of the characteristics which suggest affinity with Caryophyllaceae and not seen in the original Hordle material. Diameter of tubercled areas about 0·05–0·14 mm. On the broken surfaces the columnar character of the testa is clear, part of the columnar effect being due to the toothed "cell" margins, the teeth forming ridges on the sides of the "cells". No inner integument can be seen in this specimen. Diameters of distorted seed, 2·3 × 1·75 mm.

Family Nymphaeaceae

Genus ***BRASENIA*** Schreber

Brasenia ovula (Brongniart)

(Pl. 31, figs. 40, 41)

1926. *Brasenia ovula* (Brongniart) : Reid & Chandler, p. 99, pl. 6, figs. 15–18. See also for other references.

The typical shining ovoid seeds of this species occur throughout the strata at Hengistbury Head. They show the embryotega and the columnar section and clawed or digitate surface cells characteristic of the species as well as variation of form and size. Two specimens here figured measure 2·5 × 2 mm. and 2·25 × 1·25 mm. respectively. Both were much compressed in fossilization. In addition seeds were preserved at 19 ft. and 25 ft. above the basal pebble bed (V.36394, V.36395).

Family Burseraceae

Genus ***PALAEOBURSERA*** Chandler, 1960 : 202

Palaeobursera sp.

(Pl. 31, figs. 42, 43)

Description. A pyrene suboval in outline, much compressed dorsiventrally in fossilization but the dorsal surface must originally have been slightly convex. Facets of the ventral surface meeting to form a median broad longitudinal angle extending throughout the length, angle pierced at a short distance below the middle by the transverse aperture making the point of entry of the funicle. Germination valve occupying the upper three-quarters of the dorsal surface obscured partly by adherent tissue (of the fruit?). Wall formed superficially of equiaxial cells about 0·027 mm. in diameter. Length of pyrene, 2 mm. ; breadth, 1·25 mm.

Remarks. The solitary specimen closely resembles a species from the Lower Bagshot awaiting publication under the name *P. lakensis* but is somewhat smaller than that species, possibly due to shrinkage. In its compressed state it is not possible to estimate the number of pyrenes in the fruit.

Family Vitaceae

Genus ***VITIS*** (Tourn.) Linnaeus

Vitis sp.

(Pl. 31, figs. 44, 45)

Description. *Seed* : Broadly obovate in outline, now dorsiventrally flattened, originally somewhat inflated, markedly stipitate with a thick but definite stipitation,

not channelled at the apex, contours smooth and rounded. Dorsal surface originally convex (now crushed almost flat), chalaza narrow oval situated rather above the middle, not appreciably sunk, without conspicuous furrows above or below. Ventral surface originally faceted (now flattened) with parallel rounded raphe ridge. Ventral infolds deep, broad, short, not reaching the base, sub-parallel with a slight tendency to diverge and broaden upwards, scarcely extending to a quarter of the length of the seed from the apex. Cells of the testa equiaxial, concave, about 0·018 mm. in diameter. Thickness of testa 0·165 mm. Length of seed, 3·25 mm.; breadth, 2·6 mm. (increased by compression of seed).

Remarks. A single seed similar to some awaiting description from the Lower Bagshot of Lake, differing chiefly in the absence of a deep apical emargination and of furrows both above and below the chalaza on the dorsal surface. Without a large range of material it is impossible to be sure that this is a constant and specific difference, moreover the Hengistbury seed is much compressed.

Family Theaceae

Section Taonabeae

In 1957 Chandler (p. 111) described from the Bovey Tracey Lignite of Devon three species of seeds with pitted testa and inverted U-shaped cavities under the name *Myrtospermum* a form-genus of the family Myrtaceae. *M. variabile* from the Bournemouth Freshwater Beds (V.34248) was cited as the type species (1957 : 112). Recently Professor P. I. Dorofeev in a personal communication has very kindly called attention to the resemblance between these supposed Myrtaceae seeds and the pitted seeds of *Eurya*, Theaceae, a family of which he had been making a study. Accordingly the detailed anatomy of herbarium material of the Theaceae was examined, the material being supplied by the courtesy of the Director of the Royal Botanic Gardens, Kew. The seeds available show that there is a closer correspondence between the fossils and seeds of certain genera of Taonabeae than exists in the seeds of Myrtaceae. These genera in addition to the characteristic coarse surface pits (which may appear as convexities if an outer thin epidermis is preserved) also show layers of small equiaxial cells inside the pitted surface. The number of these layers varies in different genera or species and may also vary in different parts of the seed in some species. The absence of this coat had been noted in studying the more comparable Myrtaceae such as *M. beckleri* and *M. viellardii* which had been compared with the fossils on account of their inverted U-shaped cavities and coarse-celled testa. Again the condylar cavity between the two limbs of the seed in Taonabeae is more sharply defined and agrees exactly in form and structure with that of the fossils.

The study of the Recent material available for dissection suggests that the limits of the genera in the Taonabeae are not always clear in the seeds although a larger range of material might demonstrate true generic differences. Thus *Eurya japonica*

Thunb. (R. D. Oldham, No. 92, Nagasaki) showed only a slight bent cavity which was comparable with that of *Adinandra dumosa* Jack (Botanic Gardens, Singapore, S.F.N. 24975). *Eurya japonica* var. *nitida* Dyer (W. Borneo, Pontianak Mondi, 267) showed a hooked cavity with the micropylar limb at least twice as long as the chalazal. In *Cleyera* sp. (El Salvador. J. M. Tucker, 653) the inverted U-shaped cavity agreed exactly with the fossil, the micropylar limb being only slightly longer than the chalazal and the condyle identical in its form and structure. Whether all species of *Cleyera* are constant in these respects could not be ascertained and the fossils can therefore be referred tentatively only to the genus but definitely to the section Taonabeae. The pitting of the surface in the species of *Eurya* and *Adinandra* seen was relatively coarser and as it followed the curvature of the bent or hooked cavities did not correspond so closely with the fossil as did that of *Cleyera*.

The species to be transferred from Myrtaceae to Taonabeae and provisionally to *Cleyera* (which is treated by Engler as a sub-genus of *Eurya*) are as follows : *Myrtospermum variabile, M. boveyanum, M. dubium* and *Myrtospermum* sp. (Chandler, 1957 : 112–113, pl. 16, figs. 160–174) and the following in Chandler (1960) *M. variabile* (p. 80, pl. 8, figs. 8, 9 ; p. 108, pl. 11, fig. 18 ; p. 335, pl. 34, figs. 16–18). *M. warreni* (p. 81, pl. 8, figs. 10, 11) and possibly Genus? (p. 81, pl. 8, figs. 12, 13). *M. cooperi* (p. 106, pl. 11, figs. 13–17). *Myrtospermum* sp. (p. 335, pl. 34, fig. 19). *Myrtospermum* sp. (p. 336, pl. 34, fig. 20). (*Myrtospermum* sp. (p. 108, pl. 11, figs. 19, 20) apparently does not belong to Taonabeae.)

The position of the genus *Palaeorhodomyrtus* (Reid & Chandler, 1933 : 436, pl. 23, figs. 21–31) calls for further examination in the light of these studies as does that of *Hightea* (Reid & Chandler, 1933 : 439).

Genus ***CLEYERA*** DC.

The seeds under discussion above occur in many English Tertiary deposits. Their outline approximates to circular, oval or triangular, they are somewhat flattened or lenticular. They split marginally into symmetric valves. Within is an inverted U-shaped cavity the limbs which are separated by a condyle, being slightly unequal. The large hilum is marginal at the end of the condyle, the chalaza is close to the nilum, terminal or sub-terminal on the inner side of the shorter broader limb ; the raphe lies in the thickness of the condyle between the limbs, it is recurved and folded upon itself in its passage to the chalaza. The micropyle is marginal adjacent to the hilum and terminal on the longer limb. The testa is hard, in the majority of species at least two or three layers of compact parenchyma surround the seed-cavity. They are succeeded, sometimes abruptly, sometimes gradually, by one or more layers of large prismatic cells radially or obliquely aligned with reference to the seed-cavity. In some specimens these large cells appear simple, in others they are obviously formed of fine parenchyma, a structure revealed more clearly by decay and abrasion.

Cleyera ?variabilis (Chandler)

(Pl. 31, figs. 48–56)

1957. *Myrtospermum variabile* Chandler, p. 112.
1960. *Myrtospermum variabile* Chandler, pp. 80, 108, 335, pl. 8, figs. 8, 9; pl. 11, fig. 18; pl. 34, figs. 16–18.

About a dozen seeds from several horizons at Hengistbury have been compared with specimens from the Bournemouth Freshwater Beds and the Highcliff Sands, Cliff End, near Mudeford. There can be no doubt as to their identity. One somewhat distorted seed shows the curved limbs and U-shaped form particularly clearly (Pl. 31, fig. 54). This and several other specimens show the external pits separated by rounded ridges. Along the middle of the ridges are grooves indicating planes of weakness. This particular character is not usually apparent in seeds from other horizons but can be seen after careful scrutiny in a few specimens. As in the more typically abraded specimens from Cliff End and Sandbanks the pits and ridges of the Hengistbury seeds are built up of small rectangular cells.

Family Thymeliaceae

Genus *DAPHNE* Linnaeus

Daphne sp.

(Pl. 31, figs. 46, 47)

Description. *Seed*: Obovoid, probably originally tapering to the pointed hilum, but the original form is doubtful as the hilar end is burst and broken. Probably anatropous (by analogy with living forms) more or less symmetrical. Testa and raphe abraded. Micropyle (by analogy with living) at the broken end. Chalaza at the rounded end indicated by a small aperture, 0·1 × 0·125 mm. in diameter, marking the point of entry of the raphe. Tegmen thick, about 0·1 mm. in transverse section but thinner towards the micropylar end, hard, brittle (as suggested by the cracking which has occurred). It is preserved in dull surfaced amorphous pyrites mud. External surface of equiaxial cells 0·025–0·03 mm. in diameter, but abraded so that at the angles between adjacent cells tiny apertures are exposed giving the whole surface an evenly pitted appearance the walls themselves being obscure. There are no large scattered depressions. In section the wall is formed of slightly curved columns, the curvature being convex towards the micropyle. Their inner ends produce polygonal shining slightly convex cells on the inner surface of the tegmen somewhat smaller than the cells on the outer surface. Length of seed (burst and imperfect at the hilar end), 2·25 mm.; maximum diameter, 1·75 mm.

Remarks. One poorly-preserved seed now completely disintegrated. It closely resembled a seed of *Daphne* from the Lignite above the Boscombe Sands at Southbourne. In the broken state of the specimen it was impossible to be sure whether it ever possessed a comparable elongate-pointed hilar end. The slight tumescence

which occurs over the chalaza of the Southbourne seed has not been seen, moreover the pits on its surface mark the cell cavities not the angles of the cells as in the Hengistbury fossil. These differences may, however, be the result of different degrees of abrasion rather than specific characteristics.

Family Epacridaceae

Small subglobular five-loculed loculicidal fruits with solitary pendulous seeds occur in the Bournemouth Marine Beds, the Highcliff Sands and the Lower Headon of Hordle. Their general anatomy and cell-structure suggest that they belong to Epacridaceae. One poor specimen only has been found at Hengistbury.

Drude (1891) divides Epacridaceae into three sections: the Prionoteae and Epacrideae each with loculicidal capsules having several- to many-seeded locules, and the Stypheliae with solitary pendulous seeds in four-, five-, or ten-loculed fruits. Drude states that in this third section the hard bony syncarpous fruits are not loculicidal and are generally indehiscent. Some means of egress for the germinating seed must however have existed, and it is possible that prolonged maceration (as in fossilization) would reveal loculicidal planes of weakness not apparent in normally ripened fruits. It is probable therefore that the fossil species belong to the section Stypheliae with its single-seeded locules and pendulous seeds. In the absence of fuller information the fruits are referred to a form-genus *Epacridicarpum*.

Genus *EPACRIDICARPUM* nov.

Diagnosis. A form-genus for fruits referable to Epacridaceae of which the nearer relationship is not known.

Epacridicarpum mudense n. sp.

(Pl. 31, fig. 57)

Diagnosis. Fruits five-loculed, suboblate-sphaeroidal five-angled capsules, the angles overlying the locules, axis fibrous. External surface rough with elongate rugosities. Seeds solitary. Length of capsule, 1–1·1 mm.; transverse diameter, 1·2–1·45 mm.

Holotype. Brit. Mus. (N.H.), No. V.36486 from the Highcliff Sands, Cliff End near Mudeford, Hampshire, awaiting publication.

Description. Part of a five-loculed oblate-sphaeroidal capsule appears to be comparable with *Epacridicarpum mudense* now known from Hordle and Cliff End, Mudeford. This better material awaits publication. The Hengistbury specimen shows only two carpels, still united with loculicidal dehiscence. The external surface has shallow depressions over the septa producing slight wing-like projections over the locules. The external surface is somewhat rough, formed of equiaxial cells giving an unevenly pitted appearance. Locule lining shining, formed of long narrow cells (0·009 mm. broad) which diverge from the apical placentae situated at the

inner angles of the locules. The remains of a placenta? (or shrivelled seed?) can be seen in one locule. Length of capsule, 1 mm.; breadth across the two united carpels, 1·1 mm. Maximum radius from axis to external surface, 0·75 mm.

Family Cornaceae

Section Mastixioideae

Genus *MASTIXICARPUM* Chandler, 1926 : 35

Mastixicarpum crassum Chandler

1926. *Mastixicarpum crassum* Chandler, p. 36, pl. 6, fig. 5, text-fig. 18.

The specimen was found in an ironstone concretion full of lignitic fragments. It is to be figured in a forthcoming monograph on the Lower Bagshot for convenience of comparison with material from other localities.

It shows the typical large germination valve extending throughout the length and occupying about one-quarter of the circumference. The median infold on the valve and the U-shaped locule are seen where the specimen is transversely fractured. The plane of weakness down the middle of the infold and the sutures which delimit the valve are visible and the radially arranged fibres of the wall. Length of endocarp, 9·75 mm.; maximum transverse diameter, 5·5 mm.

Family Symplocaceae

Genus *SYMPLOCOS* Jacquin

Symplocos sp. (?*Symplocos headonensis* Chandler)

(Pl. 31, figs. 58, 59)

Description. *Endocarp*: Woody, subovoid (somewhat flattened in fossilization), truncated at the apex by a depression originally occupied by the perianth disc which has disappeared. Four-loculed, with the four apical apertures opening into the apical depression. Apertures and locules unequally developed. Basal scar of attachment marked by a small depression displaced owing to the distortion of the endocarp. Seeds project from two of the locules (they have been partially squeezed out by pressure in fossilization), two were visible in one locule and one in another. Surface of endocarp smooth, structure obscure. Surface of seeds formed by elongate cells arranged in rather irregular and sinuous groups. Length and breadth of endocarp, 5·5 mm. (as laterally compressed). Greatest diameter across the apical depression, 2 mm.

Remarks. In spite of its poor condition the characters are unmistakably those of *Symplocos*. It probably belongs to *Symplocos headonensis* Chandler (1926 : 40) a form common at Hordle, present also at Sandbanks (Bournemouth Freshwater Beds) and Arne (Lower Bagshot).

Family ?

Genus ***RHAMNOSPERMUM*** Chandler, 1925 : 30

Rhamnospermum bilobatum Chandler

(Pl. 32, figs. 60, 61)

1925. *Rhamnospermum bilobatum* Chandler, p. 30, text-fig. 13.
1926. *Rhamnospermum bilobatum* Chandler : Chandler, pl. 5, fig. 1*a–c*.
1926. *Rhamnospermum bilobatum* Chandler : Reid & Chandler, p. 117, pl. 8, figs. 1, 2.

Specimens are of common occurrence. They show the characteristic bilobed form and polygonal cells. Most are so abraded that the shining inner coat is exposed wholly or in part. Many have been flattened in fossilization but a few show the typical inflated form. The true systematic position of this problematical " seed " is still obscure. It is now known from many horizons and is fully described and discussed in a mongraph of the Lower Bagshot flora awaiting publication. The size of the species, if indeed it is a true species, is very variable. The Hengistbury material only varies in length from 2 to 2·2 mm. The breadth across the lobes which are flattened one upon the other is 1·2–1·5 mm. The surface cells are about 0·018–0·027 mm. in diameter.

In the dark basal sands at the west end of the Headland several seeds (V.36415, V.36416) were found and were so abraded that only an inner integument was preserved. A much battered seed was also found 40 ft. above the basal pebble bed in the Upper Hengistbury Beds (V.36414). Some specimens are from 25 ft. above the pebble bed (V.36411, V.36412).

Incertae Sedis

Carpolithus cornutus n. sp.

(Pl. 32, figs. 62–66)

Diagnosis. *Fruit* : One-loculed, approximately bisymmetric with a median longitudinal angle in the plane of symmetry, splitting along the angle into subequal valves. Base prominent, apex projecting, pointed. Each valve bears 5 or 6 solid large pointed horns or spines in the upper two-thirds (? tips of a persistent perianth). Length of fruits about 4·5–5 mm. ; breadth, 4·75–5·5 mm.

Holotype. Brit. Mus. (N.H.), No. V.36417.

Description. The species is represented by two mature fruits and at least one, perhaps two, immature specimens. Mature fruits are one-loculed, more or less bisymmetric with a projecting horn-like apex which is longitudinally angled in the plane of symmetry. The fruits split along the angle into two more or less equal valves. There is a prominent basal attachment 1 mm. broad, and a projecting pointed horn-like apex. Each valve bears several spines in the upper two-thirds, 6 were counted on one valve of a mature fruit, fewer (but some were broken) on the

other valve. The pyritized wall is seen in section in the broken spines. Below the spines the fruit wall is smooth and longitudinally striate due to longitudinally aligned and elongate cells about 0·027 mm. broad. Much of the surface is obscure owing to sand pitting but near the tip of one spine small inflated oblong cells can be seen parallel to the length of the spine.

Locule walls compact and lignified (cell-structure obscure) 0·114–0·17 mm. thick. Outside the compact wall there is a thicker but looser textured coat of which the cells lie parallel with the surface of the fruit when the coat is seen in section. Locule lining striate, the striations and cells which produce them diverging from the attachment and longitudinally aligned. The alignment indicates an organ at each end of the fruit. When best preserved the cells are seen to be rectangular, 0·027 broad, black and shining, very slightly toothed. The horn-like spines appear to be formed from the outer coat ; they are solid in section and show no sign of a cavity. Sometimes the outer coat peels off from the surface of the fruit leaving exposed a smooth endocarp destitute of spines which have come off with the outer coat (? exocarp). Examination of an immature fruit suggests that the horns and outer coat may be produced by a persistent perianth and bracts for in this specimen they do not appear to be completely fused to form an integument (Pl. 32, fig. 65). Length of one fruit from basal attachment to tip of apical spine, 4·5 mm. ; breadth, 5·5 mm. (tip of one spine incomplete). Length of a second specimen, 5 mm. ; breadth, 4·75 mm. (one spine slightly imperfect at the tip). Length of immature specimen, 2·5 mm. ; breadth, 3·25 mm.

Remarks. Three specimens described above and a fourth doubtful immature specimen. All are somewhat distorted by compression parallel to the plane of approximate symmetry. In the immature fruit (if the same) the individuality of the bracts or perianth segments which form the horns is clearly shown.

It is tempting to connect these horned fruits with *Trapa* but the superficial likeness is dispelled by careful comparison. In *Trapa* there are always four conspicuous horns. There may be subsidiary horns borne on the main ones as in specimens from Reuver making as many as eight in all. The apical " crown " (style base) is a conspicuous feature.

There is some resemblance in the one-loculed endocarp with solitary (? basal) seed to Juglandaceae but none of this family has the conspicuous horn-like processes, nor the close-textured compact endocarp. There is no trace of basal lobing as in Juglandaceae.

The relationship has not been discovered.

Carpolithus sp.

(Pl. 32, figs. 67, 68)

A small pyritized flattened fruit 2 mm. long, 2·2 mm. broad at the apex is subtriangular in outline with convex apex, slightly concave sides and rounded narrowed base. It thickens towards the broad apical end where a series of bracts free at their tips are fused to form the fruit below. There is one projecting fruit or pointed

bract with three angles or ridges. Four fused bracts lie on one side of it and two which partially embrace it on the other. On the flat broad surface of the fruit there are three longitudinal ribs alternating with four furrows on one side (that which terminates in four bracts) while on the other side there is one median furrow. The specimen appears to be surrounded by a thin perianth.

Its general appearance recalls a bract of *Alnus* female cone but the structure does not correspond in detail. Moreover the base is smoothly finished not ragged or truncated like the base of an alder scale which has been torn from the cone. It may be a small fruit, perhaps immature, rather than a cone-scale.

Carpolithus sp.

(Pl. 32, fig. 69)

A tiny apical (?) fragment of the valve of a woody endocarp. The external surface has a flat rim 0·3–0·5 mm. broad. Within the rim is a coarse network of ribs. Inner surface more or less smooth. Apex (?) somewhat pointed. Maximum length and breadth of fragment about 2·5 mm.

Carpolithus sp.

(Pl. 32, figs. 70, 71)

Several fragments of a smooth-walled thin woody endocarp. One specimen is somewhat flattened and has a truncate end (apex ?) (Pl. 32, fig. 70), rounded base with slight rim round side and base delimited by a shallow groove from the median flat broad area. Length about 2·5 mm. ; breadth, 2·25 mm.

The specimen has broken and shows two locules lying side by side within the breadth of the specimen. A pair of apertures at the truncate end lead into the two locules. External surface with scattered dimples or depressions. Wall in section lignified and shining, structure obscure but fine-celled. Internal surface encrusted with pyrites so that the cell-structure is hidden.

A fragment of a second specimen (V.36424) shows in addition to the irregular dimples small equiaxial cells, 0·023 mm. in diameter. Another fragment (Pl. 32, fig. 71) may also belong to the same species from its surface characters.

Carpolithus sp.

(Pl. 32, fig. 72)

A shining semi-translucent lining layer of a crushed elongate suboval fruit shows three small blunt stylar prominences at the narrower end. The broader end is truncated by a large aperture which may mark the site of a scar of attachment now torn away as the margin here is thin and slightly irregular. Whereas the specimen was probably originally inflated it is now collapsed and crumpled. Within some of the folds remains of a rough thicker outer carbonaceous coat can be seen but its

structure is obscure. Surface of the shining coat formed of rounded more or less equiaxial cells at least 0·057 mm. in diameter, sometimes instead of being strictly equiaxial there is a tendency for these cells to be slightly transversely elongate. There are also indications of an inner (?) layer of transversely elongate narrow cells. Length of fruit including style, 1·8 mm.; breadth, 0·75 mm.

In the absence of more abundant material and better evidence, no attempt is made to determine the specimen although certain features such as the three styles and the cell-structure suggest Cyperaceae. The specimen would certainly be recognizable again.

11. *Plant Remains from the Bartonian of Barton Cliffs (Horizons A1 to L of Burton, 1933), Hampshire*

GYMNOSPERMAE

Order CONIFERALES

Family Araucarineae

Genus ***ARAUCARITES*** Presl

? ***Araucarites sternbergi*** Goeppert

See p. 201.

A small twig fragment about 36 mm. long, with slender falcate leaves was figured by Gardner, referred doubtfully to this species, and alluded to on p. 59 of his account of *Araucaria goepperti* from the Bournemouth Freshwater and Marine Beds (1883: 55–59). The fragment came from the "Middle Bagshot of Highcliff" at Barton (= Lower Bartonian) and was in the British Museum collection. In the absence of further evidence its specific identity must be regarded as doubtful but its appearance strongly suggests *Araucarites*. It is unlikely that Gardner who knew the genus well at Bournemouth would have been mistaken. He refers elsewhere (1887: 249) to "branches of apparently the Bournemouth *Araucaria*" in the Highcliff Beds. Reasons for referring it to the species *Araucarites sternbergi* are given on p. 201.

Family Abietineae

Genus ***PINUS*** Linnaeus

Pinus sp. (? ***Pinus bowerbanki*** (Carruthers))

(Pl. 32, figs. 73, 74)

1850. ? *Pinites dixoni* Bowerbank (pars) *in* Dixon, p. 84, pl. 9, fig. 4.
1878. ? *Pinites bowerbankii* Carruthers *in* Dixon, p. 163.
1884. *Pinus bowerbankii* (Carruthers) Gardner, pp. 68, 69, pl. 13, figs. 6, 9.

Description. *Cone*: Elongate-ovoid, about 8·5 cm. long as preserved, but imperfect at both base and apex, much compressed laterally, about 4·1 × 2 cm.

in transverse diameter. About forty scales appear to be still attached, but are difficult to count owing to the decayed condition of some of them. They show rhomboidal apophyses, the largest being about 17 mm. broad and 10 mm. deep, having a prolonged slightly recurved dorsal umbo and a marked transverse carina ; below the carina the apophyses are ornamented with divergent striae. The specimen was rapidly disintegrating at the time of its discovery in 1938. It differs from a cone ascribed to *P. dixoni* (Bowerbank) Gardner (1884) in the larger more sharply carinate apophyses (Pl. 33, figs. 75–79). It also differs in exactly the same way from somewhat similar cones of *P. dixoni* from Hengistbury (p. 202, Pl. 29, figs. 12, 13 ; Pl. 30, figs. 14,15). Probably therefore it must be regarded as distinct from *P. dixoni*. It must, however, be remembered that living pines show considerable variation both in size of cone and in the size of apophyses in a single species ; also, that the fossils are in a poor condition which adds to the difficulty of determination. A second cone (V.32596) now rapidly decaying was found by F. C. Stinton at Horizon C.

The characters described and figured above suggest relationship with a cone collected by Gardner at Bracklesham and figured by him as *P. bowerbankii* (Carruthers) (1884 : 68, pl. 13, fig. 9). In his account of this cone he stated that the type of *P. bowerbanki* was no longer extant and that this ill-defined species was based by Carruthers on mutilated and possibly incorrectly described material. He concluded, therefore, that whereas the resemblance between cones he had himself examined from Bracklesham, Sheppey and Highcliff (1884, pl. 13, figs. 6, 9 ; pl. 14, figs. 3, 8) was such as to place them, in his opinion, in a single species, the relationship of this species to Carruthers' original *P. bowerbanki* must remain doubtful.

According to Keeping (quoted in Gardner, 1884 : 69) cones of *P. bowerbanki* have occasionally been abundant at Highcliff.

It may be noted, that Reid & Chandler transferred Sheppey cones referred by Gardner to *P. bowerbanki* to *Pityostrobus* sp. (1933 : 94) but that further consideration of the matter necessitates a return to the original ascription to *Pinus* (Chandler, 1960 : 120).

Pinus sp. (? ***Pinus dixoni*** (Bowerbank))

(Pl. 33, figs. 75–79)

1884. *Pinus dixoni* (Bowerbank) : Gardner, p. 66, pl. 13, figs. 1–5, 8 ; text-fig. 27 on p. 67.
1933. *Pityostrobus dixoni* (Bowerbank) : Burton, p. 151.

An elongate-ovoid cone was found by E. St John Burton in a dark, rather sandy and gritty clay at Horizon D (cf. Burton, 1933 : 142, 151). The cone was 11·6 cm. long, 3·9 cm. broad but was much compressed so that in life it must have been somewhat narrower. Unfortunately it fell to pieces immediately as commonly happens with such cones but not before Burton had made a rough sketch of it. A few of the scales were figured and sent to Prof. R. Florin of Stockholm for examination. He reported (23.x.35) that the material sent was too fragmentary and

badly preserved to justify exact determination. The determination of isolated pine-cones, he stated, must be based on a study of the apophyses. In the case in question, however, only a few detached scales could be sent to him and these were badly compressed and probably considerably altered in appearance. Moreover there was no indication as to what part of the cone they came from while scales often look somewhat different at the ends of a cone.

He concluded, " However, I think there can be no doubt that the cone with its large number of scales belongs to the sub-genus *Diploxylon*. It seems probable that it resembled more or less the cones of certain Recent species belonging to the groups *Lariciones* and *Australes* of G. R. Shaw (1914). The apophyses seem to have been rhomboidal, or, according to the drawing irregularly pentagonal in outline and they possess a dorsal prolonged umbo and a transverse carina.

" In the dimensions of the cone . . . as well as in the structure of the apophysis the Barton cone resembles *Pinus dixoni* (Bowerb.) Gardner . . . This species is of course not very well defined as being based on an imperfectly preserved material. But I doubt if there is much more to be done than to refer it, with or without query to *Pinus dixoni*, hoping that some day a more satisfying material will be found."

The discovery of well-preserved *P. dixoni* at the top of the Lower Hengistbury Beds at Hengistbury Head (p. 202, Pl. 29, figs. 12, 13 ; Pl. 30, figs. 14, 15) lends support to the provisional determination of the poorly-preserved Barton clay specimen more especially as *Nummulites prestwichianus* (a Barton species) has been found by D. Curry a few feet above in the Upper Hengistbury Beds (i.e. 15 ft. above the basal pebble bed of the Hengistbury Series) (see Curry, 1942).

In a letter dated 29th October, 1935, Burton reported that he had formerly obtained another similar cone in the Lower Barton Beds (A1) (cf. Burton, 1933 : 135, 151) and that the species could also be collected from the Middle Bartonian (Horizon E). He also listed the same species at Horizons A3, A1, E, ?H (1933 : 151).

Family Taxodineae

Genus ***SEQUOIA*** Endlicher

Sequoia couttsiae Heer

(Pl. 33, figs. 80, 81)

See p. 204.

Twigs obviously referable to *Sequoia couttsiae* Heer, a species abundant in beds above and below occur at various horizons in the Barton Beds. They are not very common and are usually encrusted with pyrites (Burton, 1933 : 137, 142, 151). In the Lower Bartonian at Horizon A3, the Middle Bartonian (Horizon D) and the Upper Bartonian (Horizon L), specimens in better condition have recently been obtained. Even so, the condition does not lend itself to cuticle preparation, and the specimens are very liable to decay completely. Burton lists *Sequoia* sp. at Horizons A3 and D (1933 : 151).

CONIFERAE

Family ?

Genus ?

(Pl. 33, figs. 82, 83)

Two minute twig tips with short broad imbricate scale-like curved leaves with fringed margins recall the young twigs found in the Bournemouth Marine Beds awaiting publication (as *Cupressistrobus gardneri* Chandler; see also Chandler, 1960 : 62, 112). Without more and better preserved material it is impossible to make a satisfactory determination.

ANGIOSPERMAE

Class MONOCOTYLEDONES

Family POTAMOGETONACEAE

Genus ***LIMNOCARPUS*** C. Reid emend. Reid & Chandler, 1926 : 68

Limnocarpus headonensis (Gardner)

(Pl. 33, figs. 84–86)

See p. 205.

Two subovoid locule-casts of *Limnocarpus* evidently belong by their size and proportions to *L. headonensis* although in the absence of the endocarp itself evidence of the external rugosities is not preserved. The curved form of the carpel is clear with large rounded lobe below and smaller one above, the two being separated by a long oblique groove (cast of condyle) on each broad surface. In one specimen the cast of the keel (or germination valve) is preserved. It is sub-triangular in outline, rounded below, pointed above, not reaching the style with a conspicuous median longitudinal ridge and less marked marginal longitudinal ridges. Abraded indications of style and stalk can be seen in one specimen only. Length of endocarp about 1·75 mm.; breadth in plane of symmetry, 1·2 mm.; thickness, 1·2 mm.

Family HYDROCHARITACEAE

Genus ***STRATIOTES*** Linnaeus

Stratiotes hantonensis Chandler

(Pl. 33, figs. 87–95)

See p. 205.

Typical seeds of the species were found in a very water-worn condition so that their longitudinal ridges were much obliterated. Some were suboval in outline with projecting rounded " collar ", others sigmoidal. Seeds inflated with more or

less clearly differentiated flattened narrow keel merging into the collar or terminating against it. Collar smooth, marked off by a constriction from the body of the seed. Testa woody coarsely pitted (the pits about 0·05 mm. in diameter). Pits are more or less longitudinally elongate and aligned. Micropyle basal or sub-basal, sometimes traversing the collar obliquely. Hilum on the keeled margin variable in position, at the extremity of the hook at the chalazal end in sigmoidal seeds, towards the base or half-way along the margin in hooked seeds. Raphe marginal to the apex in hooked seeds then passing directly across the keel to the apical chalaza. Possibly abraded along the margin in sigmoidal seeds remaining only as a short transverse canal across the upper end of the keel. Digitate cells of interior of keel longitudinally aligned, occasionally slightly sinuous. The seeds (allowing for their more worn condition) are identical with specimens from Southbourne, Hengistbury and the Highcliff Sands, Cliff End, Mudeford. Some are small examples but equally small or smaller ones occur at Southbourne. Length of seeds, 3 mm.; breadth, 1·5–1·6 mm. A fragment (not measured) shows a somewhat broader seed. Seeds are from Horizons A2, A3 (V.36431–36435) and there are a few seeds collected by H. Eliot Walton, labelled " Bartonian " (V.36436).

Stratiotes headonensis Chandler

(Pl. 33, figs. 96, 97)

1923. *Stratiotes headonensis* Chandler, p. 125, pl. 5, figs. 1–3, 24–26; pl. 6, fig. 23.
1925. *Stratiotes headonensis* Chandler: Chandler, p. 14.

A valve of a seed (incomplete at the micropylar end) shows the typical flat keel with highly contorted cells on its inner surface, also the long marginal raphe, and marked longitudinal ribs of *S. headonensis*. It has been compared with specimens from Hordle and there can be no doubt as to its specific identity.

Family Cyperaceae

Genus *CARICOIDEA* Chandler, 1957 : 86

Caricoidea obscura Chandler

(Pl. 33, figs. 98–105)

See p. 207.

A number of fruits and endocarps which cannot be distinguished by their structure from typical specimens of *Caricoidea obscura* from Highcliff Sands, Cliff End, Mudeford (see p. 207) although they tend to be somewhat larger. Length of fruit, 2·3 mm.; breadth, 1·75 mm. Length of another specimen, 2 mm.; breadth, 1·5 mm. The fruit in fig. 99 shows at the apex a three-rayed ridge perhaps originally associated with three styles. That in fig. 100 appears to have been larger and broader when perfect, the mucronate endocarp is partly obscured by remains of fruit in the lower half. It should possibly be regarded as distinct, but on the other hand the different appearance may be due to differential abrasion. The length and breadth, as preserved, are 1·5 mm.

The Barton endocarps are similar to typical *C. obscura* in their external surface. Some have a markedly conspicuous mucro. Some contract gradually to the basal neck while in others the neck is more distinctly defined (Pl. 33, figs. 102–104) but there appear to be no grounds for separation into more than one species. Length of an endocarp, 1·25 mm. ; breadth, 1 mm. Length of another, 1·25 mm. ; breadth, 0·9 mm.

Class DICOTYLEDONES

Family Nymphaeaceae

Genus ***BRASENIA*** Schreber

Brasenia ovula (Brongniart)

(Pl. 33, figs. 106, 107)

See p. 210.

The seeds have been often described and are too familiar to need more than a record here.

Fragments too incomplete to be worth illustrating but showing typical digitate cells aligned in longitudinal rows have been obtained by D. Curry at Horizon A3. Abrasion sometimes produces the effect of equiaxial cells at the surface, about 0·016 mm. in diameter. Seeds are also common in Beds K and L (V.36446–36449).

Family Capparidaceae or Theaceae?

Genus ?

(Pl. 33, figs. 108, 109)

Description. *Seed* : Subcircular in outline, somewhat reniform owing to a marked emargination at the hilum, bisymmetric, probably splitting marginally for germination in the plane of symmetry, but one valve is largely destroyed. Cavity inverted U-shaped, the " U " formed by the inner integument (tegmen), now much decayed. Limbs very unequal, the micropylar limb considerably longer than the other which is broader. Both limbs rounded at the extremities. Axis between limbs oblique to the straight side of the semicircular outline. Internally there is a short condyle between the limbs, externally there is a broad thick funicle. Seed when perfect much inflated. Testa deeply foveolate externally, the large pits about 0·05 × 0·025 mm. in diameter superficially are seen in section to occupy about one-third of the thickness. These pits are aligned parallel with the outline of the seed and are elongate radially. They become very small towards the centre of the seed and at the tips of the two limbs. Structure of the inner part of testa obscure but apparently formed of several rows of small square cells about 0·01 mm. in diameter. Lining of seed-cavity of long narrow cells which diverge from the condyle crossing the limbs transverse to their length. Maximum diameter of seed about 1·75 mm. (estimated, slightly imperfect) ; breadth measured across the two limbs, 1·4 mm.

Remarks. One imperfect seed shows the characteristic form and surface of

certain Capparidaceae or Theaceae. Form and ornamentation combined with size appear distinctive but the specimen is now badly decayed so that no name has been given.

Family Anonaceae

Genus ***ANONASPERMUM*** Ball emend. Reid & Chandler, 1933 : 184

Anonaspermum sp.

(Pl. 34, figs. 110–113)

Description. *Seed*: Subovoid, somewhat compressed, bisymmetric, ruminate, the ruminations coarse varying in thickness and length, irregularly transverse over the middle of the seed and diverging at one end (probably at both but only one exposed), anastomozing, branching and bifurcating near the margin, sometimes continued from side to side, sometimes interrupted over the middle ; cells decayed. Length of seed, 9 mm. ; breadth, 7 mm.

Remarks and affinities. One seed collected by H. Eliot Walton. It is broken in half along the plane of symmetry through the marginal raphe and chalaza. Both halves are now incomplete. One half retains the testa much decayed and coated with pyrites. The character of the ruminations makes the relationship with Anonaceae clear. As stated by Reid & Chandler (1933 : 182) the generic and specific characters are not well defined in the seeds of this family hence the fossil must be referred to the form-genus *Anonaspermum*. In size, shape and character of the ruminations it resembles *Anonaspermum rugosum* Reid & Chandler (1933 : 186, pl. 5, figs. 21–24) from the London Clay, but it lacks the depressed central area of that species. It is said to come from the Barton Beds and is definitely from the Hampshire coast section between Highcliff and Hordle Cliff.

Family Rutaceae

Genus ***RUTASPERMUM*** Chandler, 1957 : 102

Rutaspermum sp.

(Pl. 34, figs. 114, 115)

Description. *Seed*: Gibbous in outline, not markedly inflated, not beaked at the apex. Ventral margin straight, occupied in the upper part by the elongate-triangular shallow hilar depression which extends from the apex for about two-thirds of the length of the seed. Surface ornamented with finely sinuous longitudinal ribs which may branch and anastomoze occasionally and are sometimes connected by short transverse branches ; formed of equiaxial or elongate pits about 0·027 mm. in diameter. Testa thick ; area surrounding hilar depression not quite so rugose as the broad surfaces. Length of seed, 6 mm. ; breadth, 3·75 mm. ; thickness, 2·5 mm.

Remarks. One seed which somewhat resembles *Zanthoxylon ornatum* Chandler from the Lower Headon of Hordle in size and ornamentation but it is less beaked on the ventral margin and is not so very conspicuously smooth around the hilar scar

as is that species. The latter difference may be due to the greater abrasion of the Hordle fossils but is a constant feature of them. It therefore appears advisable to refer the Barton fossil merely to *Rutaspermum* sp. until more material is available.

Rutaspermum sp.

(Pl. 34, figs. 116, 117)

Description. *Seed* : Half-anatropous, approximately bisymmetric about a plane including the hilar scar, raphe, and chalaza, inflated, sub-triangular in outline with rounded angles, having an almost straight faceted ventral margin and gibbous dorsal margin ; lateral faces smoothly convex, meeting along the dorsal margin at a rounded angle of about 100°. On the ventral facet is the sunk elongate narrowly triangular hilar scar, 5 mm. long ; 1·5 mm. broad at the widest point. Raphe canal short, curved, entering the testa at the broad end of the hilar scar. The large black circular chalaza is situated at the rounded angle on the gibbous dorsal margin. A pair of depressions form a marginal constriction between this angle and the point where the raphe enters the testa (probably marking the ventral limit of the chalaza). Surface much decayed, smooth and shining in a few better preserved patches, ornamented with finely crenulate pits like those of the middle black integument in living *Zanthoxylon* seeds. Each pit is about 0·05 mm. in diameter. Length of seed in the plane of symmetry parallel with the ventral margin, 8 mm. ; diameter at right angles to the hilar scar in the plane of symmetry, 7 mm. ; diameter at right angles to the plane of symmetry, 6 mm. ; thickness of testa where exposed, 0·5 mm.

Remarks and affinities. One seed collected by H. Eliot Walton at Barton (precise locality unknown). Characters of form, hilum, raphe, chalaza and sculpture are those of Zanthoxyleae. No comparable living genus has been recognized. Seeds of species of *Zanthoxylon* bear some resemblance to the fossil but are so much smaller as to exclude the fossil from the genus. Also the symmetrical lateral depressions appear to be without parallel among living genera. No specific name has been given and the seed has now disintegrated.

Family Icacinaceae

Genus *ICACINICARYA* Reid & Chandler, 1933 : 344

Icacinicarya pygmaea n. sp.

(Pl. 34, figs. 118–121)

Diagnosis. Endocarp gibbous in outline with slightly convex funicular margin having a rounded longitudinal ridge and gibbous opposite margin. Length, 1·4–1·5 mm. ; breadth, 1·5–1·75 mm. ; thickness, 1·1–1·4 mm.

Holotype. Pl. 34, fig. 119. Now decayed as is all the material but the characteristics are peculiarly distinctive.

Description. *Endocarp* : One-loculed, bisymmetric, with lateral funicle in the plane of symmetry. Funicular margin slightly convex, opposite margin gibbous

hence the outline viewed at right angles to the plane of symmetry is roundly triangular or more or less gibbous. Inflated so as to be elliptical in transverse section and in sections at right angles to the plane of symmetry. Funicular margin having a marked longitudinal rounded ridge which narrows towards the basal attachment. It is flanked at the apex by a pair of small apertures or short canals. Style terminal between the apertures. Base broad and slightly flattened. External surface finely nodular or rugose with rounded rugosities which diverge from the style. External cell-structure equiaxial, cells about 0·025 mm. in diameter with finely toothed outlines. At the apex, inside, a large circular micropylar scar can be seen on adherent remains of the seed, 0·25 mm. in diameter. Cell-structure of interior decayed. Thickness of wall, 0·1 mm. Dimensions of several endocarps are: 1) Length (base to style), 1·5 mm.; breadth in plane of symmetry, 1·6 mm. Thickness at right angles to this, 1·25 mm. 2) Length, 1·5 mm.; breadth, 1·6 mm.; thickness, 1·3 mm. 3) Length, 1·4 mm.; breadth, 1·5 mm.; thickness, 1·25 mm. 4) Length, 1·5 mm.; breadth, 1·75 mm.; thickness, 1·4 mm. 5) Length, 1·5 mm.; breadth, 1·6 mm.; thickness, 1·1 mm.

Remarks. Eight fruits and several fragments, of which five were perfect or almost so. The carpel wall was in all much pyritized and cracking. No such small endocarps have been seen either among living or fossil material. The smallest specimen previously recorded is *I. bognorensis* Reid & Chandler; length, 4 mm. (1933 : 355, pl. 16, figs. 37, 38). The gibbous form is also a peculiar and distinctive feature.

Icacinicarya bartonensis n. sp.

(Pl. 34, fig. 122)

Diagnosis. Endocarp bisymmetric, subglobular, with two apertures flanking the funicular canal at the apex. Length incomplete; transverse diameters, 2 × 1·75 mm.

Holotype. Brit. Mus. (N.H.), No. V.36452.

Description. *Endocarp*: Subglobular, bisymmetric, having a lateral canal for the funicle in the plane of symmetry flanked at the apex by a pair of small apertures (indicative of the small projecting horns with canals such as occur in *Iodes* and other genera). Surface much worn. Length of endocarp always incomplete (estimated length about 2 mm.): transverse diameter in plane of symmetry, 2 mm.; transverse diameter at right angles to plane of symmetry, 1·75 mm.

Seed: Represented only by traces of the testa formed of small square or polygonal cells about 0·01 mm. in diameter.

Remarks and affinities. The funicular canal and apical apertures in this bisymmetric endocarp place it in Icacinaceae and probably in the section Iodeae. The base is always incomplete but enough is preserved to show the form. The funicle is exposed by abrasion of the surface. The chief peculiarity is the small size combined with the subglobular form. It is larger than *I. pygmaea* and lacks the striking gibbous outline of that species. In addition to the holotype there are four other specimens all collected by A. G. Davis (V.36453).

Genus ? (? ***Natsiatum eocenicum*** Chandler)

(Pl. 34, fig. 123)

A fragment of one valve of a large inflated endocarp shows part of the margin. Surface ornamented with shallow concavities separated by well-defined ridges which form a network. On the locule-wall the external concavities are represented by slight convexities. External surface too abraded to show cell-structure. Locule surface also much worn with traces of what appear to be fine digitate cells. Possibly an inflated specimen of *Natsiatum eocenicum*. Maximum diameter of fragment, 6 mm.

Genus ***STIZOCARYA*** Reid & Chandler, 1933 : 336

Stizocarya sp.

(Pl. 34, fig. 124)

Description. *Endocarp* : Almost globular but obscurely bisymmetric, splitting in the plane of symmetry into equal valves. One-loculed, one-seeded, wall 1–1·2 mm. thick, formed of many layers of cells with tortuous or sinuous walls. The cells vary considerably in size and shape. The wall has a tendency to split irregularly into concentric layers, the outer layers being more compact than the inner. Locule lining formed of large digitate cells obscured by the state of preservation (shrinkage on drying having caused the inner surface to break up into small blocks). Carpel wall traversed by radially-directed cylindrical bundles of elongate cells like those which form the hair-bases in *Stizocarya communis* Reid & Chandler (1933 : 336, pl. 15, figs. 35–42 ; text-fig. 8). The bundles do not actually pierce the locule-wall but produce rounded low tumidities on its surface. On the external surface of the endocarp they give rise to circular scars about 0·15 mm. in diameter and about 0·4 or 0·5 mm. apart. Diameter of endocarp, 9·5 mm.

Seed : Represented by part of the thin papery testa and by its impression on a film of pyrites inside the locule. It is formed of angular equiaxial cells, about 0·03–0·05 mm. in diameter which are inflated externally ; a circular scar from which the cells diverge marks the chalaza.

Remarks and affinities. One much decayed endocarp from the Middle Bartonian of Barton cliff collected by W. Lennie Ames. While the evidence of the hair-bases clearly indicates *Stizocarya* the preservation of this single specimen is too poor to allow of specific determination although in size the endocarp is more or less comparable with *S. communis* (11–14·5 mm.).

Family Theaceae

Genus ***HORDWELLIA*** nov.

Diagnosis. Inferior three-loculed berries with axile placentation and numerous seeds in each locule. Seeds anatropous, bisymmetric, splitting in plane of symmetry

which passes through raphe, hilum and micropyle. Testa much thickened between hilum and micropyle. Surface deeply and coarsely pitted, wall formed of small equiaxial cells. Length of seeds very variable, often about 1–1·5 mm.

TYPE SPECIES. *Hordwellia crassisperma* (Chandler).

Hordwellia crassisperma (Chandler)

(Pl. 34, figs. 140–144)

1926. *Actinidia crassisperma* Chandler, p. 34, pl. 6, fig. 2 ; text-fig. 15.

DIAGNOSIS. That of genus.

HOLOTYPE. Brit. Mus. (N.H.), No. V.20069 from Lower Headon of Hordle, Hampshire.

Anatropous pitted seeds described originally from Hordle but in far greater detail from the Lower Bagshot (awaiting publication). Fruits unknown in the Lower Headon have now been found at Bournemouth. At Barton there are anatropous pitted seeds showing all the characters described. The seeds vary in size and coarseness of pitting but there appear to be no adequate grounds for separating them into different species. The characteristic layers of small equiaxial cells form the inner part of the testa. One seed (Pl. 34, fig. 141) is crushed dorsiventrally so as to show the hilum facing the observer. Another (Pl. 34, fig. 140) is a typical small seed such as occurs abundantly in the Lower Headon of Hordle.

Although originally referred to *Actinidia* this relationship can no longer be maintained, for in *Actinidia* the coarse external cells are visible also on the inner surface of the testa, there being no inner layer of fine cells to conceal them. In *Hordwellia* the structure of the testa with its large external pits and inner compact layers of fine cells closely resembles that of seeds belonging to the Taonabeae and they are therefore referred to this section of Theaceae. As they do not agree with any living genus yet seen, the new generic name *Hordwellia* is given.

Dimensions of seeds : 1) Length, 1 mm. ; dorsiventral diameter, 1 mm. ; thickness, 0·75 mm. 2) Length, 1·5 mm. ; dorsiventral diameter, 1 mm. ; thickness, 0·75 mm. 3) Length, 1·15 mm. ; diameter, 0·75 mm. (This seed is dorsiventrally flattened.)

Genus *CLEYERA* DC.

Cleyera ? *variabilis* (Chandler)

(Pl. 34, fig. 145)

See p. 213.

DESCRIPTION. *Seed*: Truncated oval in outline, somewhat inflated, bisymmetric parallel with the broad surfaces. Cavity inverted U-shaped as indicated by impression of condyle between limbs seen on surface and by the alignment of the external pits. Hilum a large oval scar between the limbs on the truncate margin. Surface deeply pitted, pits arranged in concentric rows parallel with the margin, smaller over the central area (condyle) between the limbs than elsewhere. Internal

structure not seen. Length of seed (measured along axis between limbs), 1·75 mm. ; breadth (across two limbs), 1·5 mm.

Remarks. A typical seed. For other remarks see pp. 212, 213.

Cleyera ? *bartonensis* n. sp.

(Pl. 35, figs. 151, 152)

Diagnosis. Seed roundly triangular in outline, obliquely oriented so that the limbs lie parallel with two adjacent margins of the triangular outline, the hilum being close to the angle between these two margins. Dimensions of seed, 3·75 × 3 mm.

Holotype. Brit. Mus. (N.H.), No. V.36469.

Description. *Seed:* Bisymmetric, splitting in the plane of symmetry into equal valves for germination (one only preserved) ; much compressed at right angles to plane of symmetry, rounded-triangular in outline, hilum at one angle of the triangle. One limb of curved seed-cavity and the condyle which separates the limbs parallel with one of the sides of the triangle which arises from the hilar angle giving to the seed an oblique orientation parallel with its greatest diameter (Pl. 35, fig. 152). Limbs unequal, the micropylar limb the more slender and straighter of the two, the chalazal limb somewhat broader and markedly curved. Micropyle terminal on the slender limb, possibly large and gaping but the orifice somewhat obscure owing to a slight break in the testa. Chalaza terminal on the other limb connected by an aperture with a conspicuous raphe canal in the condyle as in *Cleyera*? *variabilis*. Hilum at the extremity of the condylar cavity. The maximum breadth of the condyle (1·14 mm.) is exaggerated by bursting along the raphe canal. Breadth of testa measured on the suture plane about 0·2 mm. near the hilum and on the outer side of the chalazal limb ; 0·7 mm. on the outer side of the micropylar limb. Structure of testa in section somewhat obscure owing to decay, but apparently formed of small rectangular cells about 0·018 mm. in diameter. External surface of testa ornamented with coarse rounded tubercles of irregular outline many at least 0·1 mm. in diameter. (The whole surface much obscured by decay and too brittle for satisfactory cleaning.) Locule lining transversely striate, cell-structure obscure. Maximum diameter of seed, 3·75 mm. ; diameter at right angles to it, 3 mm.

Remarks. The seed is distinguished from other fossil species by the combined characters of large size and oblique orientation.

Family Thymeliaceae

Genus ***DAPHNE*** Linnaeus

? *Daphne* sp.

(Pl. 34, figs. 125, 126)

Description. *Seed:* Pointed obovoid with a slight tumescence over the chalaza at the broad end which is pierced at the centre by a small aperture. Micropylar

end pointed (slightly imperfect). Surface of integument (tegmen) black and shining formed of flat or scarcely inflated equiaxial cells each with a large pit at its centre which occupies at least half the diameter of the cell. Diameter of cells about 0·014 mm. The cells show some longitudinal alignment especially near the hilar end. The tegmen is about 0·08 mm. thick where it could be measured, columnar in section with curved columns. Length of seed, 2·25 mm.; breadth, 1·2 mm. About the same size as the species from Hengistbury but narrower and more attenuated to the base. The specimen is imperfect, the seed having cracked obliquely so that part of the testa is missing on one side.

Genus ?

(Pl. 34, figs. 127–129)

Two other fragments, probably Thymeliaceae, belong to another genus or other genera. One (Pl. 34, figs. 127, 128) shows a deep invagination over the chalaza. Where seen in section the wall is 0·1 mm. thick formed of straight columnar cells. Cells in surface view have median pits and although the surface is much decayed equiaxial cells can be distinguished about 0·05 mm. in diameter. Maximum breadth of seed preserved (near the chalazal end), 2 mm. A second fragment (Pl. 34, fig. 129) appears to belong to the family but is too poor for description. It lacks the marked invagination of the specimen in figs. 127, 128.

Family Lythraceae

Genus ***DECODON*** J. F. Gmel.

Decodon gibbosus (E. M. Reid)

(Pl. 34, figs. 130–133)

1920. *Diclidocarya gibbosa* E. M. Reid, p. 82, pl. 4, figs. 23, 25.
1929. *Decodon gibbosus* (E. M. Reid) E. M. Reid, p. 37, pl. 589, figs. 8, 9.

Description. *Seed:* Bisymmetric, inverted pyramidal, sub-triangular in side view, narrowly triangular as seen from the ventral side, the breadth in the dorsi-ventral plane of symmetry being greater than that at right angles to it. Angles and edges of pyramid rounded. Top of seed broad, sloping to the back, base somewhat roundly truncate, dorsal side with rounded longitudinal angle. Ventral side with flat or slightly concave triangular germination valve which may end in a sharp mucro below. Dehiscence begins at the pointed end and continues up the sides of the valve which, however, remains attached to the endocarp at the broad upper end. Surface of valve with several longitudinal lines of square cells or pits about 0·025–0·03 mm. in diameter. Six lines of these cells were visible in one specimen but this surface may be partially or wholly obscured by a thin epidermis showing longitudinal striations and fine equiaxial cells about 0·012 mm. in diameter. The cells tend to diverge from the basal hilar-micropylar area. Thickness of testa on dorsal

side of spongy equiaxial cells also about 0·012 mm. in diameter. Dimensions of seeds as follows: 1) Length, 1·1 mm.; maximum breadth of ventral face, 0·7 mm. Breadth of valve at upper end, 0·45 mm.; dorsiventral maximum breadth near apex, 0·825 mm. 2) Length, 0·95 mm.; maximum breadth of ventral face, 0·825 mm.; and of valve, 0·45 mm. Length of valve about 0·6 mm.; dorsiventral maximum breadth, 1 mm. 3) Length, 1·05 mm.; maximum breadth of ventral face, 0·7 mm.; and of valve, 0·5 mm; dorsiventral maximum breadth, 0·8 mm.

Remarks. Three seeds which appear indistinguishable from *D. gibbosus* (E. M. Reid), a species originally described from the Mio-Pliocene of Pont-de-Gail under the generic name *Diclidocarya* (1920 : 82, pl. 4, figs. 23, 25. See also E. M. Reid, 1929 : 37, pl. 589, figs. 8, 9). Later P. A. Nikitin referred *Diclidocarya globosa* to the living genus *Decodon* (1929 : 33–36, pl. 589) to which also *Diclidocarya gibbosa* belongs. The Pont-de-Gail seeds are slightly larger than the Barton (length, 1·2–1·4 mm.; breadth, 1·2–1·4 mm.) but in many-seeded fruits such as *Decodon* slight differences of size may be of relatively little significance. This is the first fossil occurrence of the living genus so far recorded in English strata.

Genus ***DICLIDOCARYA*** E. M. Reid, 1920 : 82

Diclidocarya minor n. sp.

(Pl. 34, figs. 134–137)

Diagnosis. Seed broadly-ovate in outline, 0·75–0·85 mm. long, 0·8–0·95 mm. broad, much compressed. Germination valve elliptical. Seed-body, distinct on the ventral surface, flanked by a spongy thickening on each side from which it is separated by a groove.

Holotype. Brit. Mus. (N.H.), No. V.36459.

Description. *Seed:* Bisymmetric, broadly oval (or roundly triangular) in outline, somewhat compressed in the direction of the plane of symmetry. Seed-body median, longitudinal, more or less fusiform, flanked on each side by a spongy thickening of the testa formed of equiaxial cells, 0·016 mm. in diameter. Operculum or germination valve as in *D. menzelii*, ellipsoid covering the lower half of the seed-body on the dorsal side. On germination the valve becomes completely detached (unlike *Decodon*) and in both specimens it had already fallen. Ventral surface with a marked broad subfusiform median ridge associated with the seed-body. Maximum breadth of ridge, 0·15–0·2 mm. Ridge separated from the lateral thickenings by a longitudinal groove on each side. Longitudinal striae on the median line of the seed-body may indicate the position of the raphe. Surface much abraded but in the holotype fine fibre-like cells are seen surrounding the plug aperture and swirling over the surface as in many Lythraceae. Length of seed, 0·75–0·85 mm.; breadth, 0·8–0·95 mm. Length of plug, 0·4–0·6 mm.; breadth, 0·2–0·3 mm.

Remarks. Two seeds, much sand-pitted with operculum fallen. Their position in the genus *Diclidocarya* is clearly indicated by the form of the seed with body flanked by spongy testa thickenings and ellipsoid operculum falling completely free.

They are markedly smaller than *D. menzelii* (with seeds 1·3–2·5 mm. long; 1·3–2·4 mm. broad), also the seed-body is more clearly distinguished from the lateral thickenings than in that species.

Genus *PALAEOLYTHRUM* nov.

Diagnosis. Seed subcircular, obovoid or obovate with or without marginal rim, wings or other conspicuous features of the testa, with median ventral raphe and subapical chalaza. Inner integument with a rough coat of transversely elongate and aligned cells overlain by longitudinal fibres.

Type species. *Palaeolythrum bournense* n. sp.

Palaeolythrum bournense n. sp.

(Pl. 34, figs. 138, 139)

Diagnosis. Seeds subcircular to obovate, bifacial with one slightly convex surface, the other flat or slightly concave, both surfaces having curved longitudinal ribs except on the broad rim which surrounds an obovate apiculate body. Anatropous with median ventral raphe and transversely striate tough inner integument. Seed-cavity shining, lined by equiaxial or oblong cells. Chalaza scar conspicuous, rimmed, on one surface at the broad extremity. Length of perfect seed, 2–2·25 mm.; breadth about 2 mm. Length of seed-body, 1·2–1·75 mm.; breadth, 0·9–1·3 mm.

Holotype. Brit. Mus. (N.H.), No. V.36487, from the Bournemouth Freshwater Beds at Branksome Dene, awaiting publication.

Description. *Seed:* Obovate (represented by seed-body), the testa having been largely or entirely removed by abrasion, bisymmetric, one broad surface being slightly concave, the other very slightly convex. Hilum at the narrow end (as demonstrated by Bournemouth material), chalaza indicated by a small deep rectangular depression on the concave surface at the opposite end of the seed to the hilum. The chalazal depression has a raised rim. One specimen (Pl. 34, fig. 138) shows longitudinally aligned slight rugosities, the remains of the outer integument, or testa, now abraded. This surface also shows longitudinal striations. From the other specimen the testa has been entirely worn away leaving only the remains of an inner coat of transversely aligned cells represented by their torn edges. They produce transverse striations except around the chalaza where they are concentric to this organ, crossing the margin of the seed-body at right angles and forming a slight rim around the sunk chalaza scar. Dimensions of seed-body: 1) Length, 1·75 mm.; breadth, 1 mm. 2) Length (less abraded specimen), 1·5 mm.; breadth, 1·15 mm.

Remarks. These seed-bodies are identical with similarly abraded material from Sandbanks and Branksome Dene in the Bournemouth Freshwater Beds. The species also occurs in the Bournemouth Marine Beds. The relationship with Lythraceae is fully discussed by the writer in a forthcoming monograph where beautifully preserved material with testa intact is described. The mode of occurrence of these specimens

which are abundant in fine silt together with Cyperaceae at Bournemouth suggests an aquatic or sub-aquatic habit which would be in keeping with the family Lythraceae.

Family Cornaceae

Section Mastixioideae

Genus *EOMASTIXIA* Chandler, 1926 : 37

Eomastixia rugosa (Zenker)

1833. *Baccites rugosus* Zenker, p. 12, pl. 1, figs. 9, 10.
1926. *Eomastixia bilocularis* Chandler, p. 37, pl. 6, fig. 6*a–e*.
1957. *Plexiplica rugosa* (Zenker) Kirchheimer, pp. 259–260, pl. 9, fig. 470 ; pl. 40, fig. 161*a–c*.

The species is redescribed and fully discussed in a forthcoming monograph of the Lower Bagshot flora where a complete list of synonyms is given. Dr. Kirchheimer has kindly examined some of the well-preserved endocarps from the Lower Headon of Hordle and is satisfied that they are identical with Zenker's species which he had described as *Plexiplica rugosa* (Zenker) before seeing the Hordle material.

Poorly preserved or rather perishable endocarps have been found from time to time in the Lower and Middle Bartonian. Typical examples are to be figured in the monograph referred to above. Two such were pyritized fruits collected by E. M. Reid and M. E. J. Chandler from the Middle Bartonian which showed the exocarp and superior perianth scar. The specimens were small and perhaps immature. Another specimen collected by W. Lennie Ames, also from the Middle Bartonian showed the endocarp with valves beginning to split both along their margins and along the median infolds. The subsequent decay of the carbonaceous endocarp revealed calcite locule-casts which reproduced the form of the two seeds.

A crushed three-loculed endocarp was found by E. St John Burton at Horizon A3, Lower Bartonian. It showed the three valves externally and, on being fractured, three locules were visible, all much compressed, one probably abortive. This specimen is referred to by Burton (1933 : 151) as an endocarp (allied to *Mastixia*).

All the specimens mentioned are now decayed. The genus is well known throughout the Hampshire and Dorset coast section from the Lower Bagshot to the Lower Headon of Hordle.

Family Epacridaceae

Genus *EPACRIDICARPUM* Chandler (see p. 214)

Epacridicarpum headonense n. sp.

(Pl. 34, figs. 146, 147)

1926. Ericaceae, Genus ? sp. 1, Chandler, p. 31, pl. 6, fig. 7*a*, *b*.

Diagnosis. Fruits suboblate-sphaeroidal loculicidal capsules with five one-seeded locules. Walls thick formed of parenchyma, axis fibrous. Length of fruit 0·55–1 mm. ; diameter, 0·1–0·15 mm.

Holotype. Brit. Mus. (N.H.), No. V.36485 from Highcliff Sands, Cliff End near Mudeford, Hampshire, awaiting publication.

Description. A slightly stipitate sub-turbinate or oblate-sphaeroidal syncarpous loculicidal capsule. Originally five-loculed now represented by two united loculicidal segments with remains of fibrous axis and one separate segment. The form, broadest near the apex and somewhat flattened on top, the rough irregularly pitted external surface (now much abraded), thick parenchymatous carpel walls, smooth shining locule lining with narrow elongate cells diverging from the subapical placenta at the top of the axis, unite these specimens with Epacridaceae. They agree with specimens from Cliff End near Mudeford and the Lower and Upper Headon Beds although the Barton specimens are small examples. No seeds seen. Length of longest fruit, 0·75 mm.; breadth across two united segments, 1·1 mm. Length of a smaller carpel, 0·55 mm.; breadth of a single segment, 0·5 mm.

? *Epacridicarpum mudense* Chandler

(Pl. 34, figs. 148–150)

See p. 214.

Description. *Fruit:* Loculicidal, approximately oblate-sphaeroidal but with greatest breadth below, syncarpous, five-carpelled, angled longitudinally over the locules, slightly concave over the septa. Locule lining smooth, cells diverging from subapical placentae on the inner angles; axis fibrous terminating at the apex in a broad flat-topped style. External surface very coarsely rugose also with deep pits. Length of fruit, 0·75 mm.; breadth (three carpels only), 1 mm. Length of a second fruit, 1 mm.; breadth (two carpels only), 1·4 mm. The fruits resemble those of *E. mudense* but are somewhat more markedly rugose in some instances.

Family Symplocaceae

Genus *SYMPLOCOS* Jacq.

Symplocos sp.

(Pl. 35, figs. 153, 154)

Description. A small inferior fruit with remains of persistent sepals and perianth disc. The sepals are so large that they suggest the fruit is immature. Fruit-body ovoid with unequally developed locules. Four gaping apertures at the apex indicate that these are four in number. Sepals appear to be bifid or lobed and probably arranged opposite to each locule but some are broken. Scar of attachment subbasal, slightly asymmetrically placed. From it a few furrows diverge up the sides of the fruit. Septa with a median plane of weakness along which there is a tendency to split. Where the planes intersect there is a central canal. Length of fruit including sepals, 3·25 mm.; breadth, 2·2 mm.

Remarks. The inferior fruit with apical perianth disc and locules opening at the apex indicates *Symplocos*. The immature condition does not permit of closer determination.

Family ?

Genus ***RHAMNOSPERMUM*** Chandler (see p. 216)

Rhamnospermum bilobatum Chandler

(Pl. 35, figs. 155, 156)

See p. 216.

The characteristic bilobed "seeds" are fairly abundant in different stages of abrasion. Some, especially the more inflated specimens, show the outer coat. Others retain only the semi-translucent tegmen. Seeds very variable in size. Typical dimensions are shown by two figured specimens: 1) Length, 1·8 mm.; breadth, 2·5 mm. 2) Length, 3 mm.; breadth (lobes folded more or less upon themselves), 2·5 mm.

Incertae Sedis

Carpolithus sp.

(Pl. 35, figs. 157–162)

Description. *Seed*: Ellipsoid, having a large gaping aperture at one end (chalaza? or embryotega aperture). At the opposite end are two small holes side by side whose purpose is not clear (Pl. 35, fig. 158 at *a*). Surface of small slightly convex equiaxial cells, 0·016 mm. in diameter. Sections of the wall show these cells to be the ends of oblique columns as in Thymeliaceae or Euphorbiaceae. Thickness of wall about 0·075 mm. The seeds show some tendency to be slightly lobed longitudinally. One seed shows three shallow furrows extending for about half to three-quarters of the length from the large aperture (cf. Pl. 35, fig. 159). Length of seeds about 2·25 mm.; breadth, 1·75 mm.; diameter of large aperture, 0·75 mm. Although the columnar coat recalls Thymeliaceae, the large aperture is unlike anything seen in this family.

Carpolithus sp.

(Pl. 35, fig. 163)

A subglobular body (seed?) ornamented with a sharp network of ridges between which are deep hollows. The ridges are irregularly serrated. The hollows are polygonal and more or less equiaxial in outline; typical hollows measure 0·1 and 0·17 mm. in diameter. A second broken specimen shows the inner surface which is light brown with irregular pock marks with no clear cell structure and somewhat spore-like in texture. Outer surface dark having a metallic appearance. No spore-like triradiate mark seen. Dr. J. W. Franks kindly examined it and states that it is not a spore. Dimensions: 1 × 0·9 mm.

Carpolithus sp.

(Pl. 35, fig. 164)

Seed transversely oval with broad surfaces and rounded margins. One surface markedly convex, the other with two unequal facets separated by an oblique angle as if caused by pressure of other seeds in a fruit. At the middle of one long margin is a round deep foramen (micropyle?), about 0·17 mm. in diameter. Surface smooth and somewhat shining, its cell structure obscure. The appearance suggests a thin epidermis covering a thick corky coat and perhaps only a narrow longitudinal seed-cavity. Length, 1 mm.; breadth, 1·5 mm.; thickness, 0·6 mm. The specimen has not been identified.

Carpolithus sp.

(Pl. 35, figs. 165–167)

A semi-globose organism, excavated deeply on the flat side, having a series of branching furrows diverging from a central point on the rounded side and extending to the margin of the hollowed face. The specimen was cracking concentrically and radially. Its subsequent disintegration showed numerous cavities radiating from the centre of the rounded surface. All were filled with matrix. Indications of these cavities can be seen on the lower margin of fig. 167. The nature of this body is obscure, possibly it was a compound fruit with associated bracts. Height, 6·5 mm. Diameter, 9·25 × 8·25 mm.

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PLATE 29

Araucarites sp. (? *Araucarites sternbergi* Goeppert)

Fig. 1. Twig. × 6·5. Marine clays between 22 and 40 ft. above basal pebble bed.

Fig. 2. Thick twig with broken and abraded leaf-tips. × 6·5. Marine clays 19 ft. above basal pebble bed.

Fig. 3. Detached leaf. × 14. Marine clays 40 ft. above basal pebble bed.

All Upper Hengistbury Beds, south-east face, Hengistbury Head.

All the above destroyed in attempts to prepare cuticle.

Pinus sp.

Fig. 4. Leaf fragment, lower surface showing three longitudinal ridges. × 20. (V.36361.)

Fig. 5. Same, upper surface. × 20.

Fig. 6. Leaf fragment, upper surface, with six lines of stomata, having a single ridge on lower surface. × 20. (Destroyed in an attempt to prepare cuticle.)

Fig. 7. Leaf fragment, upper surface, with seven rows of stomata. × 20. (V.36362.)

Fig. 8. Fragment, lower surface, with single asymmetrically-placed ridge. × 20. (V.36363.)

Fig. 9. Same, upper surface, showing six lines of stomata. × 20.

Fig. 10. Fragment, upper surface showing seven lines of stomata. × 20. (V.36364.)

Fig. 11. Same, lower surface. × 20.

Figs. 4, 5, 7–11. Marine clays 25 ft. above basal pebble bed. Fig. 6. Marine clays 15 ft. above basal pebble bed.

All Upper Hengistbury Beds, south-east face, Hengistbury Head.

Pinus dixoni (Bowerbank)

Fig. 12. Neotype. Cone, very slightly imperfect at base. × 1. (V.36352.)

Fig. 13. Same, opposite side. × 1.

Upper part of Lower Hengistbury Beds on shore at low-water mark. South-east face, Hengistbury Head.


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Pinus dixoni (Bowerbank)

Fig. 14. Lower part of cone in Pl. 29, fig. 12 showing character of the scale apophyses. ×2·7.

Fig. 15. Second more fragmentary cone. ×1. (V.36353.)

Both upper part of Lower Hengistbury Beds on shore at low-water mark. South-east face, Hengistbury Head.

Limnocarpus headonensis (Gardner)

Fig. 16. Ventrilateral aspect of a locule-cast. ×14. (Now decayed.)

Fig. 17. Same, lateral, condyle at (c). ×14.

Marine clays between 22 and 40 ft. above basal pebble bed, Upper Hengistbury Beds, south-east face, Hengistbury Head.

Stratiotes hantonensis n. sp.

Fig. 18. Valve of a seed showing external surface, sigmoidal form associated with a short raphe and small prominent collar (*c*) ; (*h*) hilum ; (*k*) keel. ×9·5. (V.36366.)

Fig. 19. Same, inner surface ; (*r*) short curved raphe ; (*h*) hilum ; (*m*) micropyle. ×9·5.

Fig. 20. Typical seed ; (*c*) collar with micropyle ; (*k*) keel. ×9·5. (V.36367.)

Both dark sands, cliff base, west end of Hengistbury Head.

Fig. 21. Relatively unworn seed. ×9·5. (V.36371.)

Fig. 22. Seed showing ridges and pits ; (*h*) hilum ; (*m*) micropyle. ×9·5. (V.36370.)

Both marine clays, 19 ft. above basal pebble bed.

Fig. 23. Small, somewhat abraded, compressed seed, ventrilateral view. ×9·5. (V.36369.)

Fig. 24. Same, dorsilateral view showing incipient separation of the two valves along the edge of the keel ; (*c*) collar. ×9·5.

Marine clays 40 ft. above basal pebble bed.

Fig. 25. An abraded seed showing collar smoothly rounded at (*c*) ; (*k*) keel. The margin is slightly broken above. ×9·5. (V.36372.) Marine clays 25 ft. above basal pebble bed.

All Upper Hengistbury Beds, south-east face, Hengistbury Head.

Scirpus lakensis n. sp.

Fig. 26. Abraded seed, inner coat only preserved. ×20. (V.36378.) Dark sands, cliff base, west end of Hengistbury Head.

Caricoidea obscura n. sp.

Fig. 27. Fruit, side. ×14. (V.36380.)

Fig. 28. Another (broken or bitten by animal at top right). ×14. (V.36384.)

Fig. 29. Endocarp released from a fruit. ×14. (V.36381.)

Fig. 30. Another endocarp partly surrounded by broken fruit. ×14. (V.36382.)

Fig. 31. Another fruit (excrescence (*e*) a patch of pyrites). ×14. (V.36383.)

Fig. 32. Another fruit with adherent tissue (bract ?) on right below. The whole surface is encrusted with pyrites and cracked. ×14. (Now decayed.)

Fig. 33. Smaller crushed fruit (immature ?) with exocarp preserved. ×14. (V.36385.)

Figs. 27, 29–31. Marine clays 19 ft. above basal pebble bed.

Figs. 28, 32, 33. Marine clays 25 ft. above basal pebble bed.

Upper Hengistbury Beds, south-east face, Hengistbury Head.

Fig. 34. Endocarp with adherent remains of fruit at base giving the appearance of an expanded neck. May belong to this species. ×14. (V.36387.)

Dark sands, cliff base, west end of Hengistbury Head.


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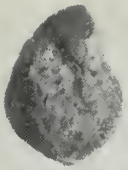
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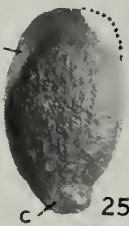

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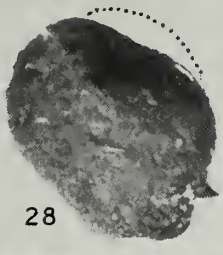
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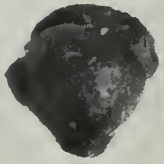
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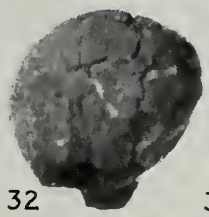
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PLATE 31

Caricoidea maxima n. sp.

FIG. 35. Holotype, fruit, side. ×14. (V.36388.) Marine clays 40 ft. above basal pebble bed, Upper Hengistbury Beds, south-east face, Hengistbury Head.

Palmophyllum sp.

FIG. 36. Fragment of leaf with pinnae arising from axis. ×9·5. (V.36389.)

FIG. 37. Same, opposite side. ×9·5.

Marine clays 40 ft. above basal pebble bed, Upper Hengistbury Beds, south-east face, Hengistbury Head.

MORACEAE, Genus ?

FIG. 38. Fruit, broken transversely, (*st*) style; (*f*) funicle where it enters to placenta. × 20. (V.36390.) Marine clays 19 ft. above basal pebble bed, Upper Hengistbury Beds, south-east face, Hengistbury Head.

Hantsia pulchra (Chandler)

FIG. 39. Seed, broken and distorted. ×14. (V.36391.) Marine clays 25 ft. above basal pebble bed, Upper Hengistbury Beds, south-east face, Hengistbury Head.

Brasenia ovula (Brongniart)

FIG. 40. Pointed-oval seed with embryotega (*e*). ×14. (V.36392.) Dark sands, cliff base, west end of Hengistbury Head.

FIG. 41. Broader seed with aperture (*a*) (split) for lost embryotega. ×14. (V.36393.) Marine clays between 22 and 40 ft. above basal pebble bed, Upper Hengistbury Beds, south-east face, Hengistbury Head.

Palaeobursera sp.

FIG. 42. Pyrene, dorsal. (*v*) Position at margin of lower end of germination valve (much obscured by adherent tissue). × 20. (V.36396.)

FIG. 43. Same, ventral showing short, upward curved aperture (*a*) for entry of funicle. ×20.

Marine clays 25 ft. above basal pebble bed, Upper Hengistbury Beds, south-east face, Hengistbury Head.

Vitis sp.

FIG. 44. Seed, ventral with short, sub-parallel infolds and stipitate base. ×6·5. (Now decayed.)

FIG. 45. Same, dorsal with small oval chalaza situated somewhat above the middle. ×6·5.

Dark sands, cliff base, west end of Hengistbury Head.

Daphne sp.

FIG. 46. Seed, side (broken at hilar end). ×15. (Now decayed.)

FIG. 47. Same, opposite side, tilted to show chalaza (small circular foramen). ×15. Marine clays 19 ft. above basal pebble bed, Upper Hengistbury Beds, south-east face, Hengistbury Head.

Cleyera ? *variabilis* (Chandler)

FIGS. 48, 49. Two seeds. ×14. (V.36397, V.36398.)

Dark sands, cliff base, west end of Hengistbury Head.

FIGS. 50–53. Four seeds. ×14. (V.36400–V.36403.)

Fig. 54. Seed showing curved limbs clearly emphasized by distortion. ×14. (V.36404.)
All marine clays 19 ft. above basal pebble bed.

Fig. 55. Small distorted seed. ×14. (V.36406.)

Fig. 56. Another small seed. ×14. (V.36407.)
Both marine clays between 22 and 40 ft. above basal pebble bed.
All Upper Hengistbury Beds, south-east face, Hengistbury Head.

Epacridicarpum mudense n. sp.

Fig. 57. Two united carpels showing two locules (*l*, *l*). (Left hand locule almost hidden behind septum.) ×14. (V.36409.)

Marine clays between 22 and 40 ft. above basal pebble bed, Upper Hengistbury Beds, south-east face, Hengistbury Head.

Symplocos sp. (? *Symplocos headonensis* Chandler)

Fig. 58. Endocarp, side, slightly distorted so that part of the apical depression is shown with apertures leading into locules. ×6. (V.36410.)

Fig. 59. Same, apex, showing obscurely the apical depression (flattened) with three of the four locules (*l*, *l*) and central canal (*c*). ×6.

Marine clays 19 ft. above basal pebble bed, Upper Hengistbury Beds, south-east face, Hengistbury Head.


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PLATE 32

Rhamnospermum bilobatum Chandler

FIG. 60. Laterally flattened seed. The dorsal lobes lie one upon the other (left). ×14. (V.36411.)

Marine clays 25 ft. above basal pebble bed, Upper Hengistbury Beds, south-east face, Hengistbury Head.

FIG. 61. Much abraded seed with only inner integument preserved. One dorsal lobe is seen towards base of figure overlain at (*o*) by the other lobe. Dorsal side to right. ×14. (V.36415.)

Dark sands, cliff base, west end of Hengistbury Head.

Carpolithus cornutus n. sp.

FIG. 62. Spiney fruit. (*a*) Attachment; (*ap*) apex. ×9·5. (V.36418.)

FIG. 63. Same, opposite side showing incipient splitting into two valves. (*a*) Attachment; (*ap*) apex. ×9·5.

FIG. 64. Holotype. ×9·5. (V.36417.)

FIG. 65. Immature specimen with bracts or perianth lobes forming spines incompletely fused. ×9·5. (Now decayed.)

All marine clays between 22 and 40 ft. above basal pebble bed.

FIG. 66. Immature specimen. This species? ×9·5. (V.36419.) Marine clays 40 ft. above basal pebble bed.

All Upper Hengistbury Beds, south-east face, Hengistbury Head.

Carpolithus spp.

FIG. 67. Fruit distorted to show bracteoles at apex. ×14. (V.36420.)

FIG. 68. Same, opposite side showing longitudinal ribs. ×14.

Marine clays 19 ft. above basal pebble bed.

FIG. 69. Tip of a large endocarp with smooth rim and coarse rugosities on the surface. ×14. (V.36421.)

Marine clays 25 ft. above basal pebble bed.

FIG. 70. Two-loculed endocarp, exterior (broken below). Two small depressions (*a*, *a*) are apertures leading into the locules. ×14. (V.36422.)

FIG. 71. Another fragment. ×14. (V.36423.)

Both marine clays between 22 and 40 ft. above basal pebble bed.

All Upper Hengistbury Beds, south-east face, Hengistbury Head.

FIG. 72. Fruit with three styles (inner layers only preserved). ×14. (V.36425.)

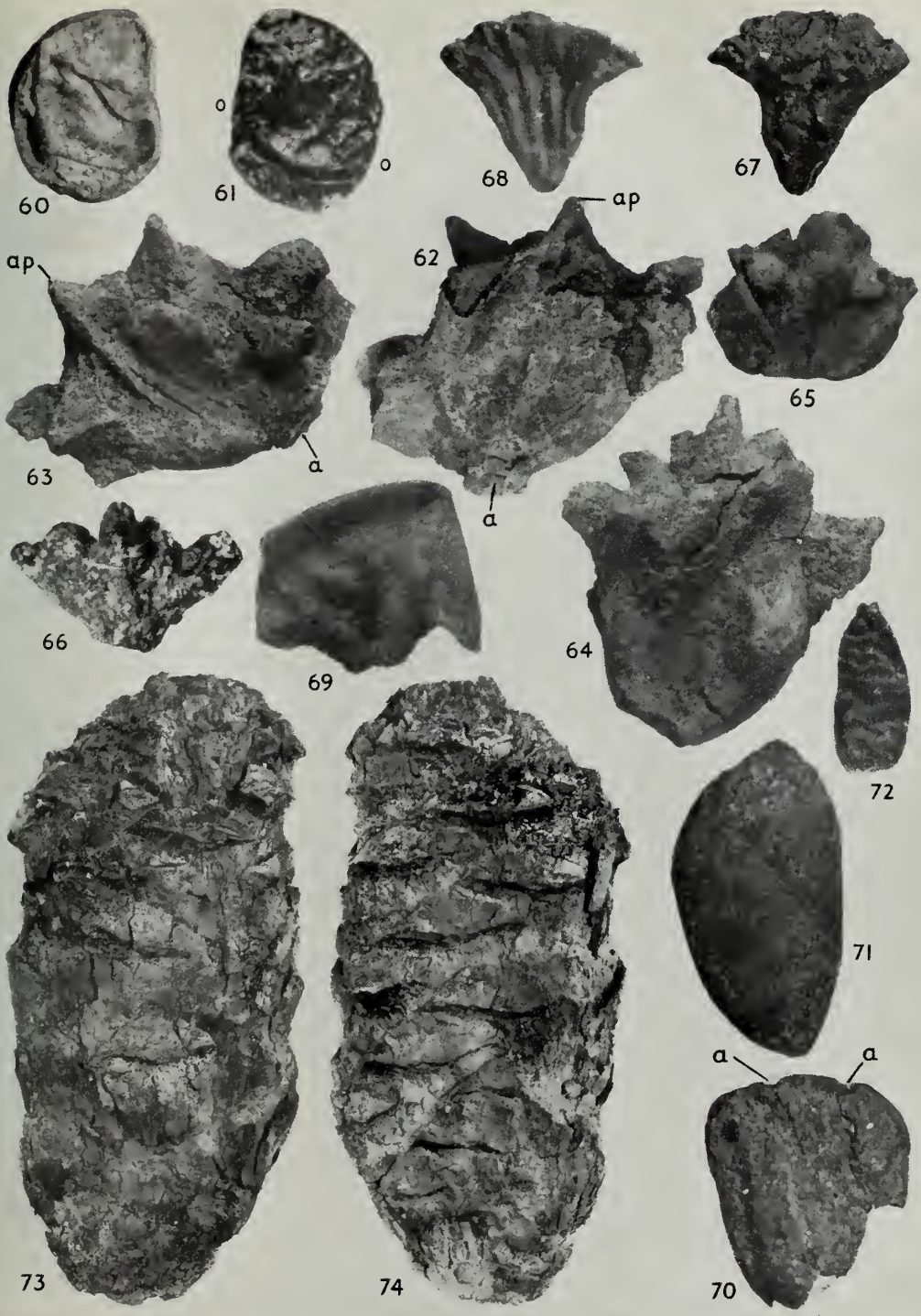
Dark sands, cliff base, west end of Hengistbury Head.

Pinus sp. (? *Pinus bowerbanki* (Carruthers))

FIG. 73. Crushed cone (slightly imperfect). ×1·1. (Now decayed.)

FIG. 74. Same, opposite side. ×1·1.

Middle Bartonian, Horizon C, Barton cliffs.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Pinus sp. (? *Pinus dixoni* (Bowerbank))

FIGS. 75–79. Detached scales of a cone (now decayed). Figs. 75 and 76, opposite surfaces of one scale, fig. 75 being the lower surface. Figs. 77–79, the lower surfaces of three other scales. ×2.

Middle Bartonian, Horizon D, Barton cliffs.

Sequoia couttsiae Heer

FIG. 80. Fragment of twig. ×14. (Now decayed.)

Lower Bartonian, Horizon A, Highcliff.

FIG. 81. Another (destroyed in attempt to prepare cuticle). ×6·5.

Upper Bartonian, Horizon L, west of Beckton Bunny, Barton cliffs.

CONIFERAE, Genus ?

FIGS. 82, 83. Two minute twig fragments. ×14. (Now decayed).

Lower Bartonian, Horizon A3, Highcliff.

Limnocarpus headonensis (Gardner)

FIG. 84. Locule-cast, side. Aperture for keel (missing) on right; (*c*) condyle. ×15. (V.36427.)

FIG. 85. Same, ventral. (*c*, *c*) Casts of condyle; (*a*) attachment. ×15.

FIG. 86. Another cast with cast of keel on right; (*c*) condyle. ×15. (V.36428.)

Both Upper Bartonian, Horizon K (Long Mead End Bed),Taddiford, Hordle Cliff.

Stratiotes hantonensis Chandler

FIG. 87. Valve of seed, external surface (broken at apex). ×6·5. (V.36429.)

FIG. 88. Another, internal surface. ×6·5. (V.36430.)

Both Lower Bartonian, Horizon A2, Highcliff.

FIG. 89. Valve of seed, exterior showing hooked form; (*c*) collar; (*k*) keel. ×8·5. (V.36431.)

FIG. 90. Same, interior, with long raphe near margin of keel (*k*); (*ch*) chalaza; (*h*) hilum; (*c*) collar. ×8·5.

FIG. 91. Micropylar end of a broken seed; (*c*) collar. ×8·5. (V.36432.)

FIG. 92. Valve (incomplete at apex), external surface; (*c*) collar. ×8·5. (V.36433.)

FIG. 93. Same, inner surface. ×8·5.

FIG. 94. Valve, exterior, showing sigmoidal form. ×8·5. (V.36434.)

FIG. 95. Same, inner surface showing short transverse raphe near apex of keel and subapical hilum (*h*); (*m*) micropyle. ×8·5.

All Lower Bartonian, Horizon A3, Highcliff.

Stratiotes headonensis Chandler

FIG. 96. Broken valve of seed, exterior, micropylar end missing. Shows ridged surface and broad flat keel. ×6·5. (V.36437.)

FIG. 97. Same, inner surface, broad keel on right bearing long marginal raphe. ×6·5.

Upper Bartonian, Horizon L, between " Black Bands ", west of Beckton Bunny, Barton cliff.

Caricoidea obscura Chandler

FIG. 98. Fruit, side. ×14. (V.36438.)

FIG. 99. Another. ×14. (V.36439.)

FIG. 100. Mucronate endocarp protruding from remains of fruit (*f*) only preserved near base. ×14. (V.36440.)

FIG. 101. Similar but smaller specimen. ×14. (Now decayed.)

Figs. 102–104. Endocarps, released from fruits. ×14. (V.36441–V.36443.)
Fig. 105. Endocarp with adherent fragments of fruit. ×14. (V.36444.)
All Lower Bartonian, Horizon A3, Highcliff.

Brasenia ovula (Brongniart)

Fig. 106. Small seed with gaping aperture (*a*) formerly closed by an embryotega. ×15. (V.36446.)
Upper Bartonian, Horizon K, east of Beckton Bunny, Hordle Cliff.
Fig. 107. Large seed (*a*) as in fig. 106. ×15. (V.36448.)
Upper Bartonian, Horizon L, between "Black Bands", west of Beckton Bunny, Barton cliff.

Capparidaceae or Theaceae ? Genus ?

Fig. 108. Imperfect seed, exterior, showing unequal limbs, deep emargination between them, and foveolate surface. × 20. (V.36450.)
Fig. 109. Same, opposite side looking into curved seed-cavity. ×20.
Lower Bartonian, Horizon A3, Highcliff.

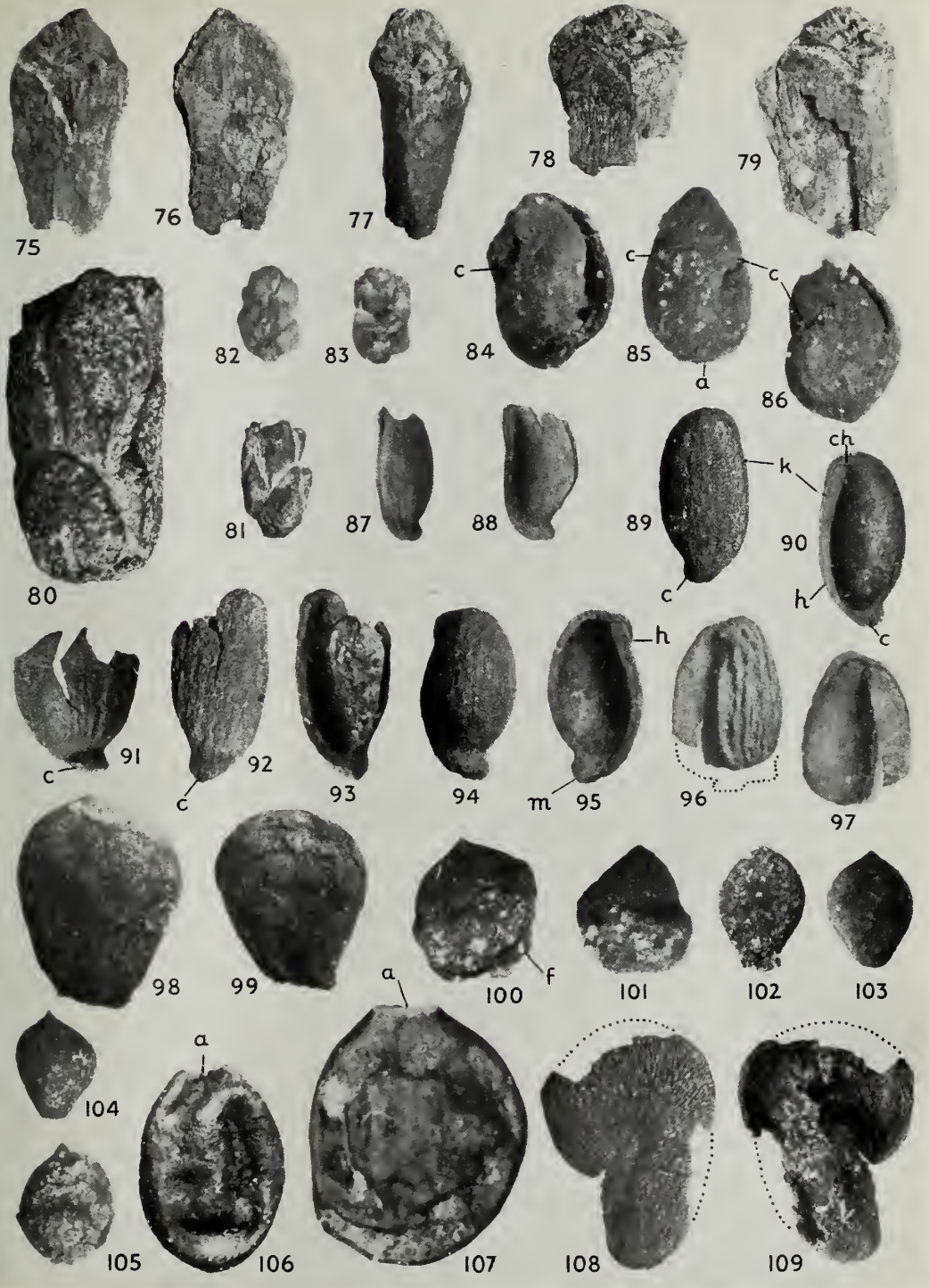
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PLATE 34

Anonaspermum sp.

FIG. 110. Seed, exterior with cracked testa part of which has come away below on the left exposing ruminate albumen at (*a*). ×2·8. (Now decayed.)

FIG. 111. Same, opposite side. The specimen had split longitudinally through the albumen parallel with plane of symmetry, hence albumen is seen from the inside. ×2·8.

FIG. 112. Part of the other half of the split albumen, outer surface showing ruminations. ×2·8.

FIG. 113. Same, inner surface. ×2·8.

Bartonian of Barton cliff or Highcliff (precise horizon not known).

Rutaspermum sp.

FIG. 114. Seed, side ; (*v*) ventral margin. ×6·5. (V. 36451.)

FIG. 115. Same, looking onto ventral margin with large but narrow triangular hilar scar in the upper two-thirds. ×6·5.

Lower Bartonian, Horizon A2, Highcliff.

Rutaspermum sp.

FIG. 116. Seed, side ; (*v*) ventral edge ; (*ch*) probable position of chalaza. ×2·8. (Now decayed.)

FIG. 117. Same, ventral margin, with broad hilar scar. ×2·8.

Bartonian of Barton cliff (horizon not known).

Icacinicarya pygmaea n. sp.

FIG. 118. Endocarp, apex. Funicle ridge median in upper half of figure, flanked at apex (centre of figure) by two canals of which the apertures can be distinguished. ×14.

FIG. 119. Holotype. Another, side. Funicle on right. ×14.

FIG. 120. Another as in fig. 118. ×14.

FIG. 121. Another, side. Funicle on left. ×14.

All Lower Bartonian, Horizon A3, Highcliff. All now decayed.

Icacinicarya bartonensis n. sp.

FIG. 122. Holotype. Endocarp, apex. Funicle above, apertures of canals which flank it seen as two white spots. ×14. (V.36452.)

Upper Bartonian, Horizon K (Long Mead End Bed), Taddiford, Hordle Cliff.

ICACINACEAE, Genus ? (? *Natsiatum eocenicum* Chandler)

FIG. 123. Fragment of large endocarp with network of external ridges, part of rimmed margin on right. ×8·5. (V.36454.)

Lower Bartonian, Horizon A3, Highcliff.

Stizocarya sp.

FIG. 124. Endocarp, side, showing small circular scars due to hair-bases. ×6·5. (Now decayed.)

Middle Bartonian, Barton cliff (horizon not known).

? *Daphne* sp.

FIG. 125. Seed broken obliquely so that apex and base are separated. External surface. Small aperture (white) at apex = chalaza. ×14. (V.36455.)

FIG. 126. Same, reverse of imperfect seed showing cavity. (*ch*) Slight tumescence marking chalaza ; (*m*) micropyle. ×14.

Lower Bartonian, Horizon A3, Highcliff.

THYMELIACEAE, Genus ?

FIG. 127. Fragment of seed with deep invagination over chalaza. ×14. (Now decayed.)
FIG. 128. Same, reversed showing interior and wall in section. ×14.
FIG. 129. Chalazal end of a seed. Interior of fragment of testa. ×14. (Now decayed.)
Both Lower Bartonian, Horizon A3, Highcliff.

Decodon gibbosus (E. M. Reid)

FIG. 130. Side view of seed, germination valve beginning to gape on left. ×14. (V.36456.)
FIG. 131. Same, opposite side. ×14.
FIG. 132. Another seed, valve on right. ×14. (V.36457.)
FIG. 133. Another, ventrilateral, valve to left. ×14. (V.36458.)
All Lower Bartonian, Horizon A3, Highcliff.

Diclidocarya minor n. sp.

FIG. 134. Holotype. Seed, dorsal, operculum (in lower half) missing. ×20. (V.36459.)
FIG. 135. Same, ventral, showing median longitudinal ridge of raphe. ×20.
FIG. 136. Another seed, dorsal. Operculum missing. Testa broken above showing seed-cavity in crack. ×20. (V.36460.)
FIG. 137. Same, ventral, showing raphe. ×20.
Both Lower Bartonian, Horizon A3, Highcliff.

Palaeolythrum bournense n. sp.

FIG. 138. Seed abraded, remains of testa represented by obscure longitudinal ridges. ×20. (V.36461.)
FIG. 139. Another, opposite surface showing sub-terminal chalazal scar (*ch*). ×20. (V.36462.)
Both Lower Bartonian, Horizon A3, Highcliff.

Hordwellia crassisperma (Chandler)

FIG. 140. Typical seed. ×20. (V.36463.)
FIG. 141. Seed, distorted so that hilum faces camera. ×20. (V.36464.)
FIGS. 142, 143. Two larger seeds. ×20. (V.36465.) (That in fig. 143 now decayed.)
FIG. 144. Another. ×20. (V.36466.)
All Lower Bartonian, Horizon A3, Highcliff.

Cleyera ? variabilis (Chandler)

FIG. 145. Seed ; (*h*) hilum. ×20. (V.36468.)
Lower Bartonian, Horizon A3, Highcliff.

Epacridicarpum headonense n. sp.

FIG. 146. Exterior of imperfect fruit, side. ×14. (V.36470.)
FIG. 147. Another valve of the same fruit, inner side showing septum between two locules (one in shadow). ×14.
Lower Bartonian, Horizon A3, Highcliff.

? *Epacridicarpum mudense* Chandler

FIG. 148. Exterior of incomplete fruit, side. Ridges overlie locules. ×14. (V.36471.)
FIG. 149. Exterior of another, side, splitting loculicidally. ×14. (V.36472.)
FIG. 150. Interior of part of a fruit showing two locules. ×14. (V.36473.)
All Lower Bartonian, Horizon A3, Highcliff.

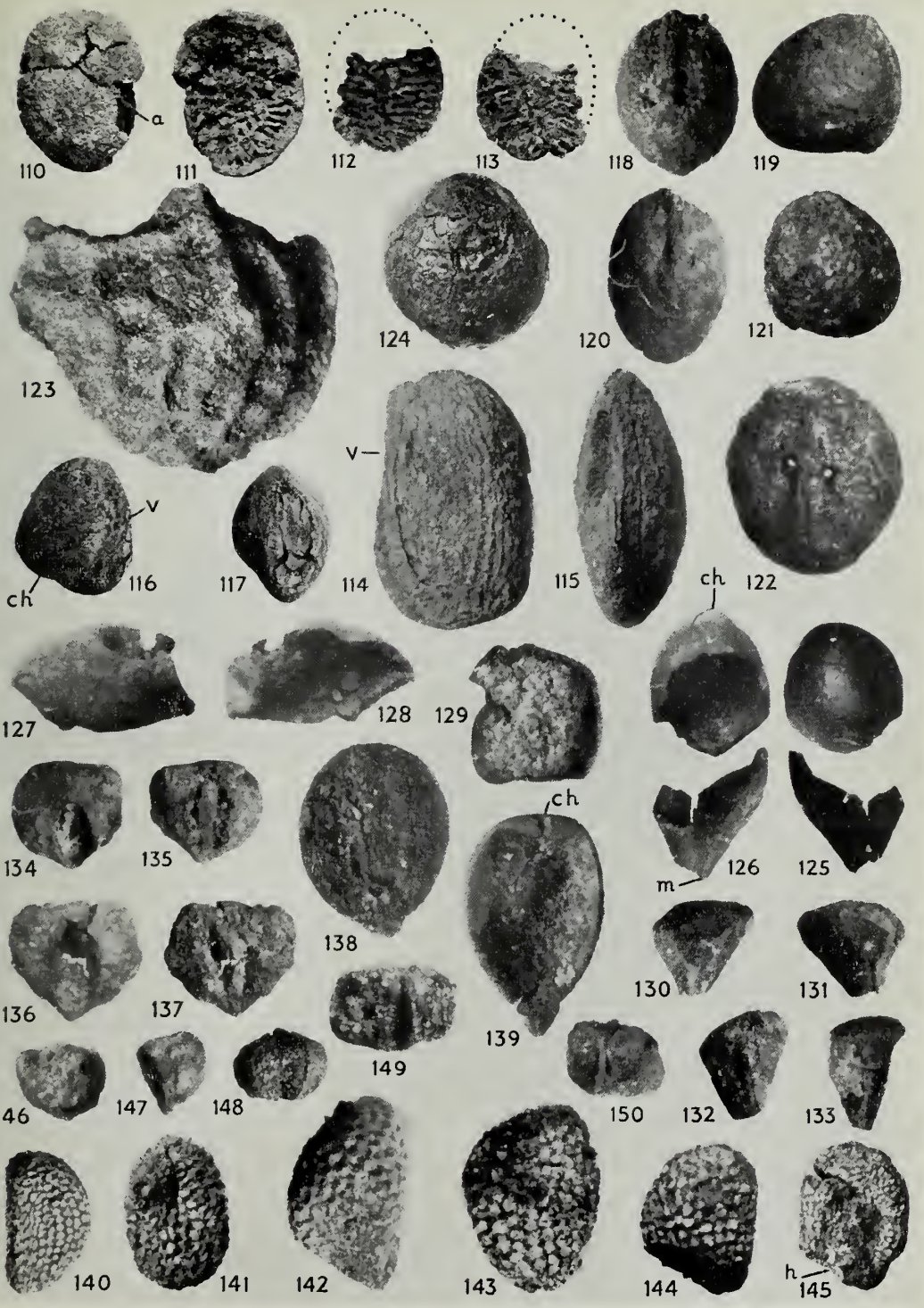
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PLATE 35

Cleyera ? bartonensis n. sp.

FIG. 151. Holotype. Valve of seed, external surface. ×6·5. (V.36469.)

FIG. 152. Same, inner surface showing obliquely oriented curved seed-cavity. ×15.

Lower Bartonian, Horizon A3, Highcliff.

Symplocos sp.

FIGS. 153, 154. Opposite sides of a young fruit with calyx still persisting. ×8·5. (V.36474.)

Lower Bartonian, Horizon A3, Highcliff.

Rhamnospermum bilobatum Chandler

FIG. 155. Dorsilateral view of large crushed seed showing two lobes and pitted surface. ×15. (V.36475.)

Upper Bartonian, Horizon L, in sand between " Black Bands ", west of Beckton Bunny, Barton cliff.

FIG. 156. Dorsal view of small uncrushed seed. ×14. (V.36477.)

Lower Bartonian, Horizon A3, Highcliff.

Carpolithus spp.

FIG. 157. Seed tilted to show large terminal aperture. ×14.

FIG. 158. Another, opposite end to large aperture, showing two small foramina (*a*, *a*). ×14.

FIG. 159. Side of the same seed. ×14.

FIG. 160. Another seed, broken longitudinally, looking into cavity. ×14.

FIG. 161. Side of seed in fig. 157. ×14.

FIG. 162. Interior of another seed fragment showing columnar wall in section. White patches are sand grains. ×14.

All Lower Bartonian, Horizon A3, Highcliff. All now decayed.

FIG. 163. Small rounded seed with reticulate ornamentation. ×14. (V.36479.)

FIG. 164. Seed. (*f*) Foramen (micropyle ?). ×15. (V.36480.)

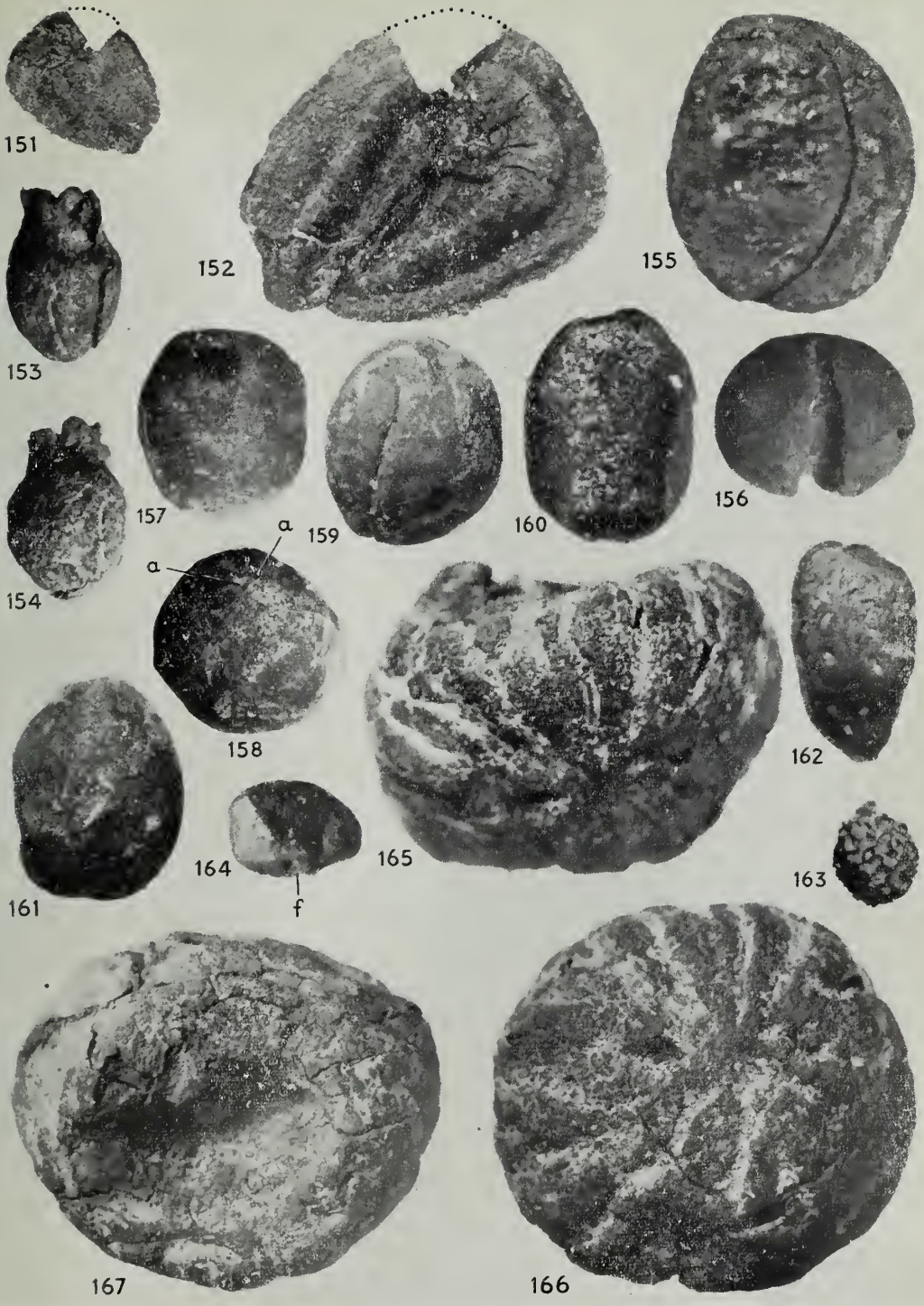
Both Lower Bartonian, Horizon A3, Highcliff.

FIG. 165. Side view of fruiting head (?) showing divergent furrows. ×7. (Now decayed.)

FIG. 166. Same, base. ×7.

FIG. 167. Same, apex showing hints of mud-filled cavities in rim near base of figure and the tendency to split along furrows parallel with a large central hollow. ×7.

Green glauconitic clay, Middle Bartonian, Barton cliff.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